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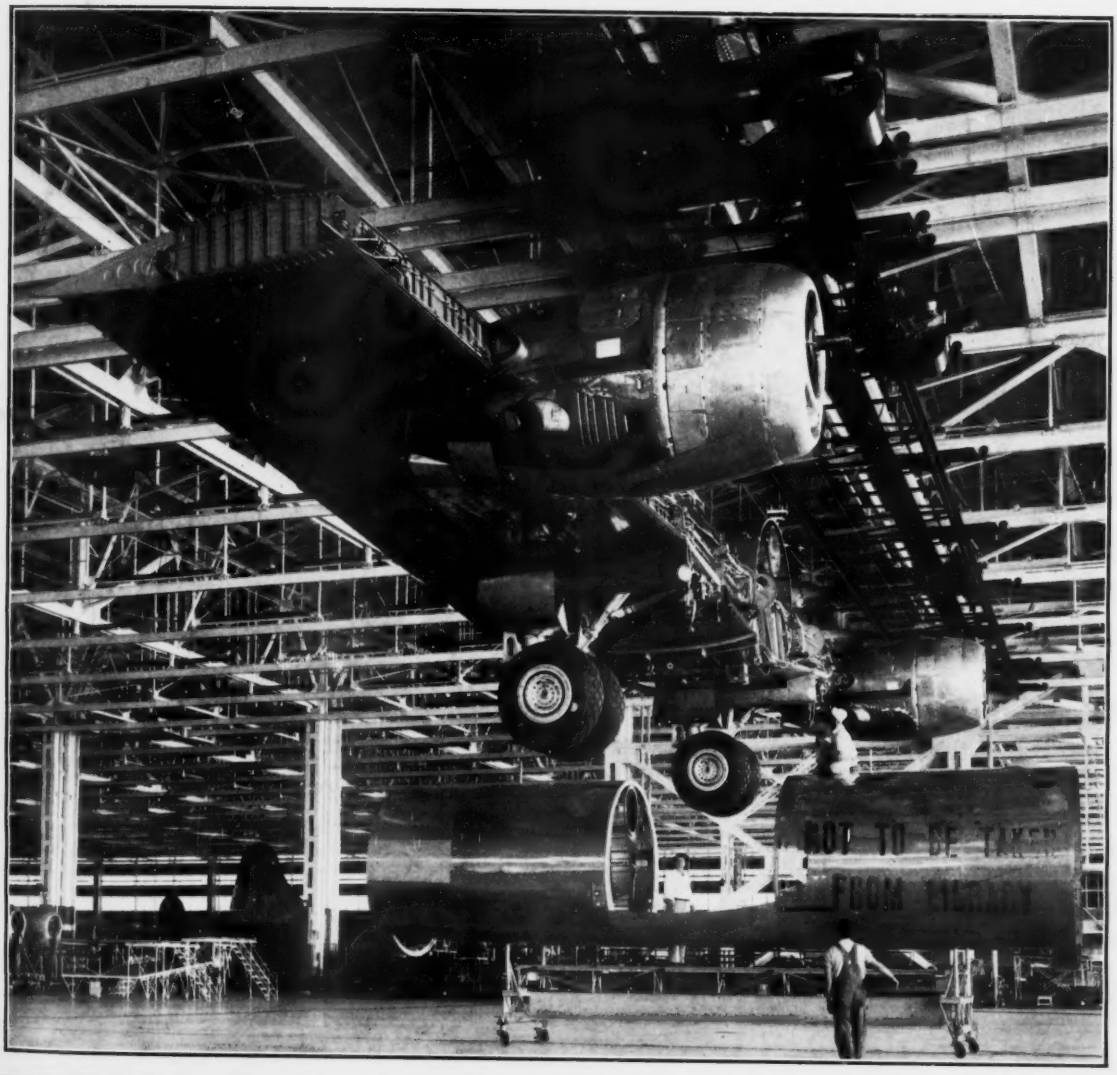
AERONAUTICAL ENGINEERING REVIEW

INSTITUTE OF THE AERONAUTICAL SCIENCES

FEBRUARY 1945



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CONTENTS

Cover Illustration

The 17-ton main center wing section of a Boeing B-29 Superfortress is lowered to join the fuselage bomb bay section at the Wichita, Kansas, plant of Boeing Airplane Company.

Articles

Emergency Equipment for Commercial Transoceanic Flight Operations . . . . . William H. Hall 7
Lighting Equipment for Adverse Weather Operations . . . . . Wilbur T. Harding 21
Structural Design Problems of Light Aircraft . . . . . Stanford J. Stelle 27

Reviews

Periodicals 61
Government Publications 123
Books 129

Air Transport and Civil Aviation, 1944–1945
Pioneering the Helicopter
Civil Aviation
Aero Digest Blue Book 1945
American Warplanes in Action
Young America's Aviation Annual 1945
Rockets, Dynamators, Jet Motors
Aircraft Vibration and Flutter
The Aircraft Annual 1945
Our Flying Navy
Manual of Aircraft Layout
Parachute Technician
Vibration Analysis
Care and Use of Hand Tools
Descriptive Meteorology
Climatology
Manual of Photogrammetry
Aircraft Mechanical Drawing
Production Engineering in the Aircraft Industry

House Organs and Catalogues 147
From the Industry 157

General

Institute News 39
Source Material 115
Appreciation to Corporate Members 158
Index to Advertisers 171

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Emergency Equipment for Commercial Transoceanic Flight Operations

WILLIAM H. HALL*
American Airlines, Inc.

Introduction

It is the purpose of this article to outline the expected requirements for commercial transoceanic emergency equipment and what may be expected, in the line of equipment, to meet such requirements. The term "emergency equipment" as it applies to this discussion will include life rafts and accessories, life preservers, and life raft communication and location equipment.

In order to clarify the development of such equipment, the military requirements and equipment will be outlined, with data being presented to show why such equipment is unsuitable for commercial use. Following this, the anticipated commercial requirements will be discussed along with the proposed equipment to meet such requirements.

Before proceeding further, however, it will be necessary to answer two questions—namely: "Why must such equipment be carried?"; "Why must attention be focused on it now?" With regard to the former, it can be said that any established carrier is required by regulation to carry specified equipment for use in emergencies. Everyone has seen the heavy axes and bars carried on railroad cars and the life preservers and life boats carried aboard ships. Likewise, life rafts and life preservers have been carried for some time on the flying boats of existing commercial overwater operators. The C.A.A. and the C.A.B. are currently revising their regulations with respect to the carrying of emergency equipment on transoceanic operation. When revised, it is expected that they will specify that adequate life rafts, life preservers, and emergency communication equipment be carried. This, of course, is simply protecting the interest of the public, and the public, being used to protective measures *on* the sea, will expect suitable protection when *over* the sea.

There are many good reasons for focusing attention on this matter at this time. The best of the production equipment available exacts too great a penalty from the carrier. It is too heavy, bulky, and inefficient. It amounts to paying too high a premium on an insurance policy not specifically suited to the individual. A second reason is that for such equipment to be used in the most efficient manner it must be specifically accommodated in the design of the aircraft. This means that some intensive effort will be required if it is expected to incorporate provisions for such equipment in the aircraft now being designed for transoceanic operation.

Present Military Requirements

In order to provide a background and at the same time outline something of the evolution of such emergency equipment, it is necessary to examine the military approach to the problem. First of all, Army and Navy equipment is generally designed for all-purpose usage. It is also designed to withstand severe usage under all sorts of conditions, including combat. For example, the Army type A-3 life raft (Fig. 1) has been used in cabin stowages in transport aircraft, blowout stowages in bombers, and as a droppable raft being thrown from aircraft to personnel in the sea. It can easily be seen that such a unit must be extremely sturdy to withstand such a combination of uses. Another good example of design for all-purpose usage is the standard Army life-preserver vest. This is equipped with scuff patches to prevent wear when worn under a parachute, a crotch strap to prevent loss of the vest on jumping into the water, and sea-marker packets for spreading colored dye on the water to attract attention. It is thus fitted for use on all types of combat aircraft on operations involving overwater flight, as well as on military transport aircraft on such missions. Likewise, the standard emergency transmitter is designed for all-purpose usage. Military ditching procedures call for this transmitter to be removed from its stowed position within the aircraft and passed to personnel in life rafts, but it can also be dropped by rescue aircraft to personnel in the sea by utilizing the small parachute that is always packed with the unit.

Existing Military Equipment

The Army and Navy currently use about seven different types of life rafts ranging from one-man parachute rafts to multiplace units capable of carrying seven persons. Of these, the Army type E-2, seven-man raft is considered the most suitable for use in Army transport aircraft. This raft, empty, weighs about 61 lbs., including full inflation gear. Its packed dimensions, when

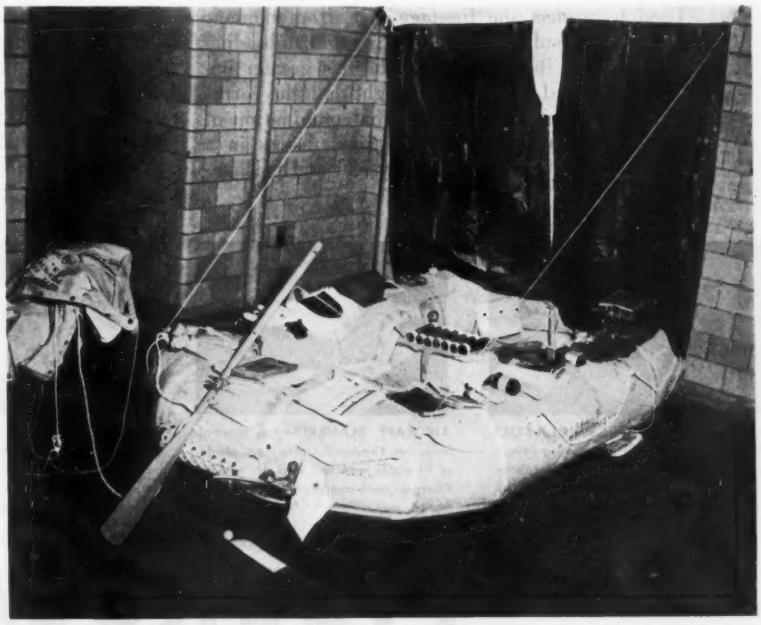

Fig. 1. Standard Army Air Forces type A-3 life raft with accessories. Rated capacity—five men.

Presented at the National Air Transport Meeting, I.A.S., Washington, D.C., October 20, 1944.

* Division Engineer—Transatlantic.

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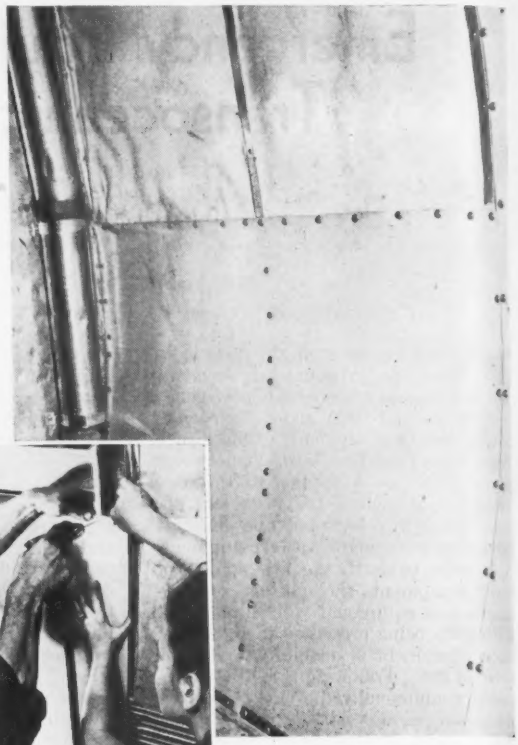

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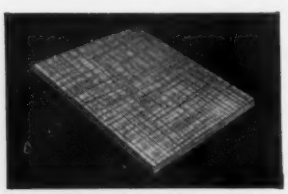
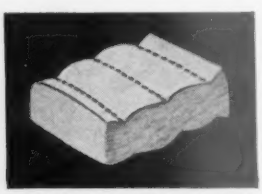
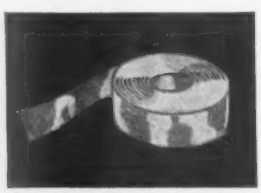


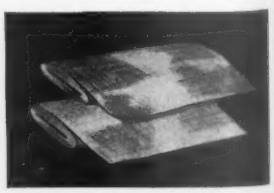
AIRCRAFT REINFORCED PLASTICS PARTS—fabricators are combining certain low-pressure resins with Fiberglas fabrics. Lightweight, impact strength, sound dampening. Used for panels and formed parts.



AIRCRAFT BLANKETS—for thermal insulation. Fireproof. Lightweight. Made of Fiberglas insulating wool, faced with Fiberglas cloth and sewn with Fiberglas thread.



AIRCRAFT TAPES—another all-glass product, woven from Fiberglas yarns. Incombustible. Used for insulating motors, generators, etc., and for lagging of thermal insulation on ducts and pipes.



AIRCRAFT COATED FABRICS—Fiberglas cloth used as a base for rubber, vinyl compounds and other coatings. Dimensional stability, high strength, humidity resistance. Used in flexible connections, etc.

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rolled, are 36 in. long by 19 in. in diameter, with accessories packed within. The total weight, including accessories required by military regulations, is about 105 lbs. This means that on a per-occupant basis the raft and accessories weigh 15 lbs. and occupy 0.85 cu. ft. per person accommodated. Among the accessories are three oars, paulin, sail, first-aid kit, pyrotechnic signal kit, two fishing kits, rations, cans of water, repair kit, hand pump, sea marker, and ten other miscellaneous items.

Communications Equipment

The standard aircraft emergency communications equipment for the armed services is the SCR-578 radio transmitter, more commonly known as the Gibson Girl because of its shape. This unit consists of a transmitter in a watertight metal case, plus an accessory case holding antenna-raising equipment and a small signal lamp. The unit will float in sea water with no detrimental effects. The transmitter sends signals on the international S.O.S. frequency of 500 kc. either automatically or by keying as desired. The power is obtained from a built-in generator operated by an external hand crank. The antenna-raising equipment consists of two balloons with two hydrogen generators plus a collapsible box kite. The balloons are used to support the antenna during periods when there is insufficient wind (less than 10 m.p.h.) to fly the kite. There is also a small parachute packed in the fabric case covering the transmitter so that the set may be dropped to personnel at sea. Federal Communications Commission tests have shown that the unit has a range of 118 miles, although the manufacturer has reports of satisfactory automatic D.F. operation up to 300 miles and satisfactory aural signals up to 500 miles from the unit. The weight of the complete unit is 33 lbs. and the total volume is 2.04 cu.ft. Over half the weight and two thirds of the volume is utilized by equipment carried to support the antenna in the air.

On some military operations a portable receiver is carried. This is a type AVR-100 receiver having a receiving range of from 200 to 400 kc., using a small battery for power. The unit, complete with battery and headphones, weighs 7 lbs. and occupies the space taken up by one balloon and one hydrogen generator that it replaces in the accessory case of the Gibson Girl.

Life Preservers

The standard life preserver carried aboard most Army and some Navy aircraft is the Army type B-4 life-preserver vest, commonly called the Mae West (Fig. 2). This consists of two separate superimposed compartments made of rubberized fabric, shaped so as to form a full collar around the neck, with the large portion being held in place across the chest and stomach with the aid of adjustable waist and crotch straps. Each compartment is connected to a separate small CO_2 cylinder attached to the bottom of the vest. Inflation is instantaneous when these cylinders are manually discharged by pulling downward on the cords attached to the two discharge levers on the cylinder holder. The CO_2 is released when the levers actuate plungers that puncture the sealing caps on the cylinders. Both compartments can be inflated simultaneously by pulling both cords, or one compartment may be inflated at a time by pulling on only one of the cords. The vest is also equipped for individual inflation of the compartments by mouth, for use if the CO_2 fails or if additional inflation is required as the CO_2 gradually leaks out. This consists of a small finger-operated valve near the top of each compartment to which is attached a short section of rubber hose. The vest weighs about $2^1/_2$ lbs.

Fig. 2. Type B-4 life preserver vest (Mae West) showing location of one of the two CO_2 cylinders and the sea-marker packet.

It can readily be seen that such equipment is unsuitable for commercial overwater operations. For example, a future airplane carrying 70 persons, including crew, would require ten type E-2 life rafts weighing 1,050 lbs., 70 type B-4 life preservers weighing 175 lbs., plus the emergency radio weighing 41 lbs., or a total of 1,266 lbs. This is slightly over 18 lbs. carried for each person aboard. In addition, it amounts to providing over 59 cu.ft. of stowage space for the rafts alone. Certainly, blowout stowages would be out of question because of the number required and the volume of each in relation to the size of the aircraft. The present emergency radio equipment should be considered as a step in the search for more adequate equipment. Much greater range is desired, plus less weight and bulk. The present unit is too large to pack inside a raft within a raft stowage, which is the best place for such equipment.

None of these remarks should be construed as condemning in any way this emergency equipment being used by the Armed Forces. It is excellent for the use for which it was designed. It is discussed here because it is the only equipment that is available and must, therefore, serve as a background for newer developments. It should be mentioned here that one type of raft was built prior to the war for use by transoceanic operators. Although this raft weighed slightly less than the Army type E-2 raft, it was also smaller, with considerably less tube buoyancy being provided. This was originally designated as a ten-man unit, but it is understood that it was subsequently redesignated as a seven-man unit. Although in many respects this was an excellent raft, it is believed that if occupant comfort is to be considered at all the type E-2 raft would be preferable. For these reasons the type E-2 raft has been used to represent the best raft available today.

Expected Commercial Requirements

Since present equipment is unsuitable, the next logical step is to try to improve it. Before doing this, however, one should examine the expected requirements to determine what bearing they may have in the matter. In this connection there are several assumptions that appear reasonable at this time. First, it is assumed that communication facilities and traffic on established routes will be such that personnel in life rafts should remain near the point of landing for quicker rescue. This eliminates provisions for raft navigation and permits emphasis on rafts designed to hold the most people per unit weight without having to consider the best shape for sailing characteristics. The second assumption is that rescue facilities will be available at points along the routes which can be equipped for flying rescue missions if required. By this it is not meant that an organization be kept solely for the purpose of air-sea rescue, but rather that this be an auxiliary function of an organization that might already be in the region for other purposes. For example, it is not absurd to consider the use of the Coast Guard as an air-sea rescue unit on the North Atlantic routes where it is already based on the iceberg patrol. It is understood that the Coast Guard is planning on investigating just such a possibility and has similar ideas with respect to other functions in other areas. The third assumption is that the record of overocean flying by commercial carriers and carriers operating under the Air Transport Command and

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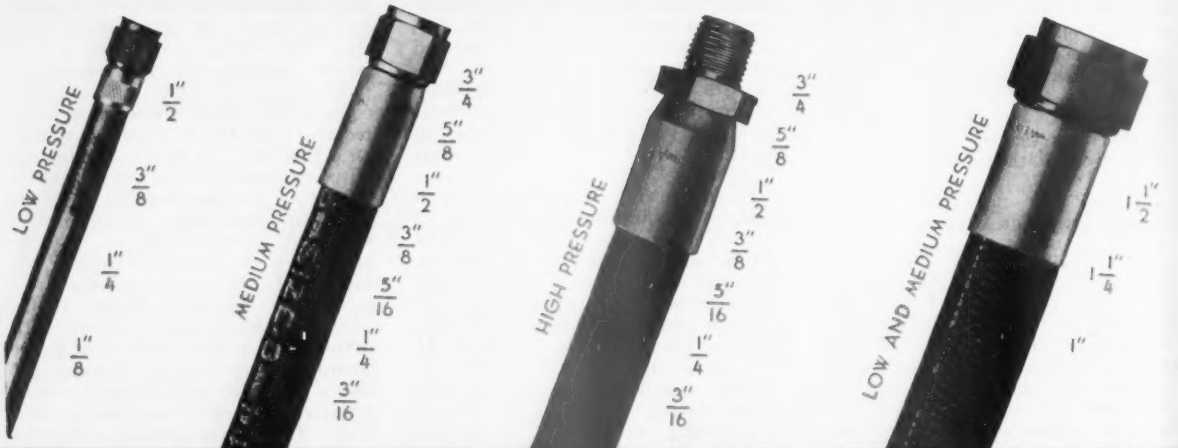
LOW PRESSURE
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HIGH PRESSURE
3/16" 1/4" 5/16" 3/8" 1/2" 5/8" 3/4"
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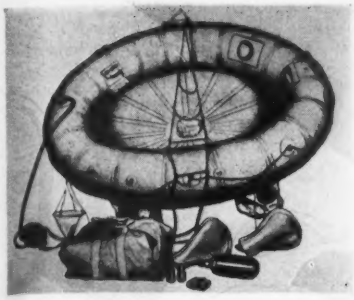


FIG. 3. One type of round life raft used by the British, with accessories laid out below.

the Naval Air Transport Service be used as a guiding yardstick.

COMFORT

A factor that has considerable bearing on the case is the extent to which life-raft comfort is to be considered. It is the general opinion that in commercial operation only that equipment which is absolutely necessary should be carried. The absolute necessities consist of adequate, seaworthy life rafts, life preservers, a suitable means of communication with or location of life rafts, exposure protection equipment, first-aid supplies, food and water rations, and attention-attraction devices. In addition to such equipment, there are several small items that weigh little and take up little space but greatly increase the efficiency of a raft as a unit.

LIFE RAFTS

There are four factors that must be considered in the design of lightweight life rafts—namely, shape, size, construction, and accessories to be carried.

Since raft navigation should not be required for the reasons previously noted, the rafts can be designed to keep the weight per person figure as low as possible, still retaining good seaworthiness characteristics. The shape that best permits this is circular. Circular rafts have been used by the British for some time (Fig. 3). They are satisfactory except that they cannot be used in combat operations that might require navigation out of enemy coastal waters. The circular-shaped raft is inherently much stiffer than an oblong raft of the same capacity and permits easier construction since tube sections are identical.

Twin-Rail Rafts

Recently, several manufacturers have experimented with twin-rail rafts (Fig. 4). This construction consists of installing a small tube around the top of the main tube. This permits the use of a small-diameter main tube, thus providing more floor area within the raft at the same time that the freeboard height is being increased. The additional rail or tube, besides creating increased floor area, provides increased rigidity, added protection from the sea, and increased safety due to compartmentation. Several experimental life rafts of the twin-rail type have been made for the Armed Forces. Life-raft manufacturers have also initiated development of both twin-rail and tri-rail rafts of lightweight construction.

This same twin-rail or tri-rail construction could be applied to a round raft with the same beneficial results. Fig. 5 shows what is believed to be the first round multitube raft ever built. It is now undergoing further development by the manufacturer's engineers.

At this time it appears that the round raft, on a point-by-point comparison, is preferable to an oblong raft. However, additional experimentation with twin-rail and tri-rail construction may make the oblong raft compare more closely with a round raft from the space availability standpoint.

FIG. 4. Six men in reclining positions in an experimental twin-rail raft during sea tests.

Factors Limiting Size and Number of Rafts

As aircraft carrying capacities increase, many factors exert their influence on the size of rafts and the number of rafts to be carried. The main factors are as follows:

(1) As the size of rafts increase, the weight per person accommodated decreases.

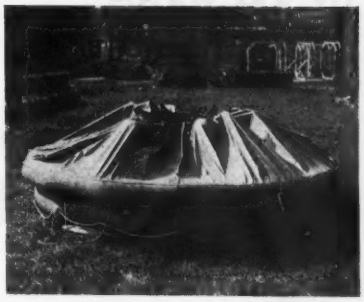
(2) There must be a compromise between "putting all the eggs in one basket," so to speak, and having so many units that stowage and use would be unduly complicated.

(3) The number of raft stowages should be kept as low as possible to reduce structure weight and the operating mechanism required.

(4) It is preferable to use only one size raft (if possible) for a fleet of the same type aircraft.

(5) There is the question of whether a given number of rafts will be carried with the aircraft at all times or whether it will vary according to the number of persons aboard a given trip.

It is believed that the minimum number of stowages on a long-range commercial transoceanic aircraft should be three. This is based on the fact that if one raft failed, it would mean the other two units would be loaded to not more than 150 per cent of their capacity. It is also thought that ten-man rafts will have their chief use in aircraft carrying less than 40 persons, including passengers and crew. This is based on the belief that the smaller stowages required for a ten-man raft, as against larger rafts, will be more easily adaptable to aircraft of this capacity.



Photograph Courtesy United States Rubber Company

FIG. 5. Experimental twin-rail round life raft showing exposure cover in place.

In an effort to obtain data on lightweight and compact life rafts suitable for commercial use, four of the leading manufacturers of life rafts were requested to submit comparisons between round and oblong rafts in ten-, 15-, and 20-man capacities. In making this request it was noted that emphasis should be placed on lightweight construction, compactness, seaworthiness, and simple operation. No particular type of construction was emphasized, this being left to the discretion of the individual manufacturer.

As soon as these estimates were received, they were tabulated, and it was found that for round rafts the estimated outside diameters and weights or given size rafts were about the same regardless of construction. It was equally apparent that the estimates on stowage volume varied widely for both round and oblong rafts. This indicated that volume estimates are unreliable under such circumstances, and it is thought that stowage volume and dimensions will not be ascertained with any accuracy until the raft is actually built. Averaging the size and weight figures on round rafts, Table 1 shows that a ten-man raft would be about 9½ ft. in diameter and weigh approximately 50 lbs. (This weight includes bare raft with built-in exposure protection plus full inflation gear.) A 15-man raft would be about 12 ft. in diameter and weigh about 62 lbs., and a 20-man raft should be about 13 ft. 3 in. in diameter and weigh 78 lbs.

With regard to oblong rafts, only five estimates were received as against eight for the round rafts. There was no comparison between the dimensions of given size oblong rafts, and, therefore, the averages might be of questionable value. However, using figures received, the ten-man oblong raft would be about 12 ft. 8 in. long and 6 ft. 4 in. wide and would weigh 49 lbs. The 15-man raft would be about 15 ft. long and 7 ft. 7 in. wide, weighing about 64 lbs., and a 20-man raft would be about 18 ft. 3 in. long and about 9 ft. wide, weighing about 83 lbs.

It will be noticed that the weight estimates on the oblong rafts are, with the exception of the ten-man size, somewhat greater than those given for the round rafts. It is believed that if such

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TABLE 1. Life Raft Estimates Comparing Round and Oblong Weight Units, Based on Average Estimates Made by Four Manufacturers.

LIFE RAFT ESTIMATES

(BASED ON AVERAGE ESTIMATES MADE BY 4 MANUFACTURERS)

RATED CAPACITY	*SIZE(FT.)	**WEIGHT(LBS.)	WEIGHT/PERSON(LBS.)	***STOWAGE VOLUME(CU.FT.)
		— ROUND —		
10	9.5(DIA.)	50	5	2.4
15	12.0(DIA.)	62	4.1	3.8
20	13.2(DIA.)	78	3.6	4.8
		— OBLONG —		
10	12.6 x 6.3	49	4.9	2.0
15	15 x 7.6	64	4.4	3.3
20	18.3 x 9.1	83	4.1	—

*SIZES ARE AVERAGES OF DIMENSIONS APPLYING TO THREE GENERAL TYPES OF CONSTRUCTION - SINGLE TUBE, TWIN RAIL AND TRI-RAIL.

**WEIGHT INCLUDES BARE RAFT, FULL INFLATION GEAR, EXPOSURE PROTECTION DEVICE AND STABILIZING GEAR.

***STOWAGE VOLUME AVERAGES ARE BASED ON WIDELY SEPARATED ESTIMATES AND ARE THEREFORE NOT TOO RELIABLE - ESPECIALLY IN THE CASE OF OBLONG RAFTS.

rafts were built the weight reduction would be even greater in favor of the round raft, since it is felt that several manufacturers were conservative on their estimates on round rafts, because they were inexperienced with their manufacture. Fig. 6 shows the experimental round raft with ten persons seated therein.

Life Raft Construction

With regard to life-raft construction it is thought that present Army Air Forces requirements concerning strength and ability to withstand temperature extremes should be retained. The emphasis must be on lightweight construction with minimum bulk, and maximum efficiency. To achieve this, lightweight fabrics, such as nylon, must be considered. Although at the present time some difficulty is being experienced with adhesion of synthetic rubber coatings to nylon fabric, several manufacturers have stated that the problems are not insurmountable and are working toward a solution, which is expected in the near future. It is thought that a somewhat greater permeability (loss of gas through tube walls) than that allowed in A.A.F. specifications might be acceptable if necessary. Present British rafts have a greater permeability than A.A.F. rafts with no detrimental effects except that they require topping up more frequently than A.A.F. rafts. Compartmentation is highly desirable as a safety factor and this should be accomplished by vertical bulkheads or individual tubes in multitube rafts. Peripheral compartmentation bulkheads should not be considered because of the heavy weight involved. The following items should be incorporated in any raft as built-in features: (1) Exposure protection capable of being rolled down and tied in place when not in use (Fig. 8); (2) ballast floor or ballast pockets to provide stability in heavy seas; (3) boarding assist ropes; (4) raft painter (lanyard); (5) heaving line; (6) raft knife and holder cemented to raft as an equipment patch; and (7) a liquid-dampened compass. There is a good possibility that present inflation gear (CO_2 bottle and head) can be lightened considerably, and this should be considered.

Accessories

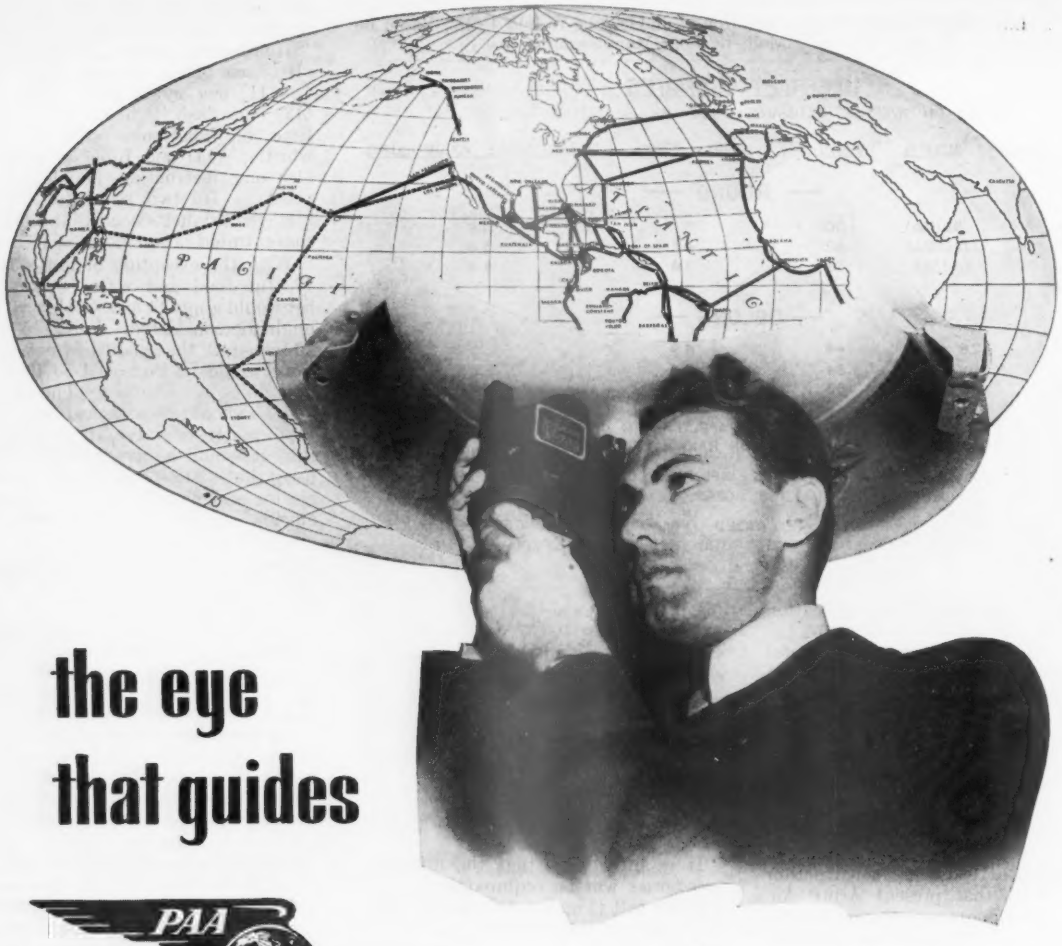
It is anticipated that the following accessories will be required for a ten-man lift raft (Fig. 7): (1) two paddles, sectional or collapsible; (2) four repair clamps; (3) one topping off pump, or bellows; (4) one sea anchor; (5) one flare ejector and flare kit; (6) two sea marker, cans; (7) one first-aid kit; (8) one bailing bucket; (9) two sponges; (10) one signal mirror, type ESM-1; (11) one nylon cord, 50 ft. long; (12) one flash light (self-lighting at time of inflation); (13) one police whistle; (14) one Bible (waterproof); (15) one instruction booklet (waterproof); (16) two sea-water desalting kits (ten briquetts each); and (17) two concentrated ration cans.

With the exception of items 16 and 17, the food and water rations, this list would apply to any size life raft that might be considered. For a 15- and a 20-man raft the quantities of such rations would be increased to three and four units, respectively. The pump or bellows should be attached to a check-type mattress valve, if possible, so that it would be available for instant use if the inflation gear failed. The flare ejector and flare kit should contain an ejector similar to the British 1-in. ejector and a minimum of 18 1-in. flares similar to the British type MK 12T. It is recommended that, if possible, the two cans of sea marker be replaced with the equivalent weight of sea-marker cartridges, designed so that they can be fired by the ejector and so that the powdered sea dye can spread over a large area instantaneously. As far as is known at present, this method of spreading sea marker has never been tried. It will be noticed that many of the items are relatively small but greatly increase the efficiency of the raft as a unit.

Accessories for the ten-man raft will weigh 24 lbs., those for the 15-man raft will weigh 28 lbs., and those for the 20-man raft will weigh 32 lbs. These accessories will occupy between 0.9 and 1.2 cu.ft. Limiting dimensions as far

Photograph Courtesy United States Rubber Company

FIG. 6. Experimental twin-rail round life raft with ten people seated on floor.



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AERIAL SEXTANTS

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FIG. 7. Anticipated accessories to be carried in a ten-man raft.

as accessories are concerned are about 25½ in., which is the length of the oar sections, and about 9½ in., which is the width of the pyrotechnic kit.

STOWAGE OF LIFE RAFTS (LOW-WING AIRCRAFT ONLY)

On present United States military transport aircraft little if any serious consideration has been given to the proper stowage of emergency equipment. In most cases the matter of installing tie-down facilities for such equipment has been left to the division or agency operating the aircraft. Most of the United States bomber-type aircraft have been equipped with blowout stowages (Fig. 8) for one or two rafts, but this problem has not received the attention and development that the British have given the matter.

It can readily be seen that in commercial aircraft carrying passengers of various ages and both sexes the launching of life rafts should be as near automatic as possible without sacrificing safety. This means that the rafts should be located in stowages on the exterior of the aircraft. In picking the best location for such stowages, it is necessary to determine first the best method of evacuating the aircraft in the water. Experience to date indicates the use of exits over the wings and the boarding of life rafts from the wing surface as the preferable procedure. Therefore, proceeding on this basis, it is evident that the location of raft stowages is limited to three places: (1) the aft portion of the wing adjacent to the fuselage, (2) the wing fillets, and (3) the fuselage adjacent to the portion of the wing. The reason that "aft portion of the wing" is specified is because sea action makes launching from the trailing edge of the wing easier than launching from any other point. The stowages should also be aft of the emergency exit location in the fuselage to permit the least confusion in boarding the rafts. The stowages should be evenly divided as nearly as possible on each side of the fuselage.

The preference in the location of the stowages is in the order given above. Wing stowage provides the nearest approach to self-launching, but several major factors are not in its favor—namely, skin and structure stresses are high in this area; the volume required usually necessitates a stowage having large wing area because of the reduced depth at this section; and it is highly possible that the stowage would interfere with other installations. The wing-fillet location should also be aft of the emergency exit with its lower edge as close to the wing surface as possible. Such a location has the advantage of utilizing space that normally is wasted, and the wing fillet is, generally, a non-structural member of the aircraft. The space available in the wing fillets will depend on the size of aircraft and is generally greater in the aft section of the fillet. The location of the stowage in the fuselage adjacent to the wing has numerous disadvantages with regard to effect on cabin interiors, desirable frame spacing, etc. It therefore appears that the wing-fillet stowage is the preferable one of the three mentioned.

Features of Stowage

There are several features that are desirable in any raft stowage regardless of its position. Each raft should be carried in a "pan" within the stowage to prevent damage and provide easier and quicker handling by maintenance personnel. Such a pan should be of light-weight construction and should be capable of being lifted out of the stowage without undue effort. It should present a smooth surface to the raft within it, thus protecting the raft on the bottom and all sides, it being open at the top. The British are contemplating the use of such a unit made of a molded black acetate plastic on certain of their bombing aircraft. The CO_2 bottle support is built into this pan so that the bottle is held rigidly in place at all times.

The stowage cover should be flush with the skin, with care being taken in its design to minimize the chances of its becoming jammed because of possible structural deformation resulting from a water landing. The cover should be held in place by a suitable number of positive latches that are disengaged during the initial travel of the release cable, after which the inflating raft pushes the cover off. Consideration should be given to the seating of this cover in a rubber grommet to prevent dirt and water from entering the stowage. The cover would also help hold the CO_2 bottle in the required position.

The way in which the raft is to be rolled or folded within a stowage will depend on the size of the raft, the space within the stowage, and shape of the stowage in each individual case. In general, it is thought that there is less resistance to inflation in a raft that is flat-packed as compared to one in the rolled form when used in a "blowout" stowage. In all cases the raft accessories should be packed within the raft and adequately secured to same.

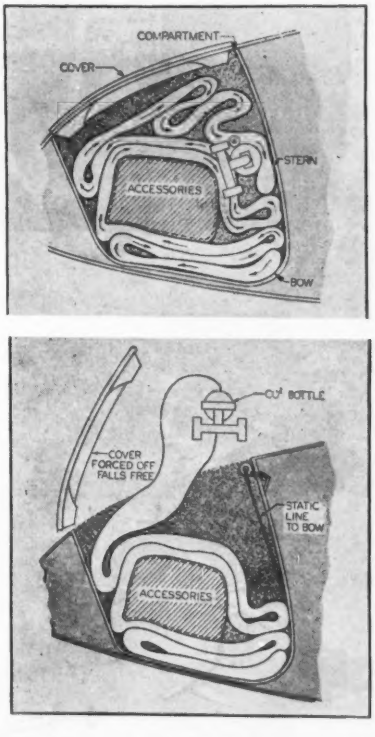

FIG. 8. (*Top*) Raft and accessories in stowed position. (*Bottom*) Initial action resulting from release of raft CO_2 bottle.

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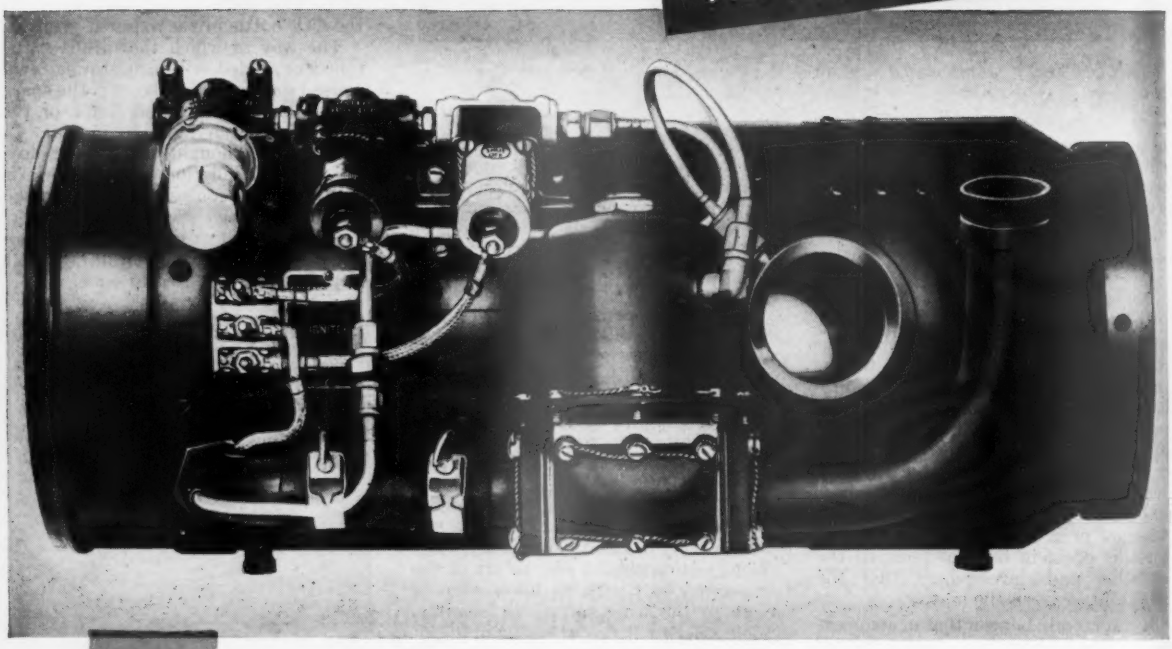

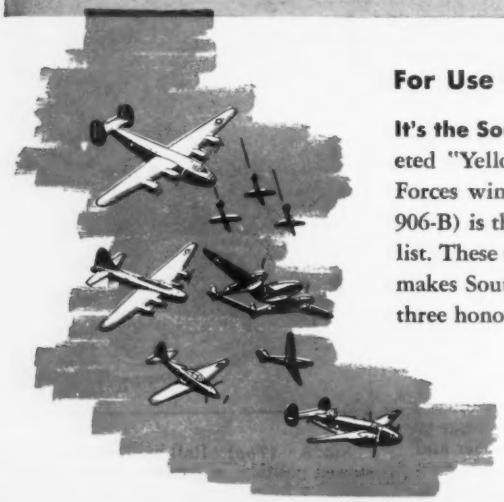

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Maximum recommended starting altitude . . . . . 20,000 feet
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Actuating Inflation

There are several methods of actuating inflation in a blowout type of stowage. One such method that is fully automatic is the submersion actuator currently in use on some British aircraft. This system consists of an immersion switch, the open end of which is flush with the belly of the aircraft such that a closed circuit is made when sea water fills the space between plate conductors. This completes an electrical circuit between the aircraft power supply and a special head on a small intermediate CO_2 bottle, causing it to discharge. The CO_2 from the bottle then enters a cylinder operating a piston that, through cable controls, disengages the positive latches on the stowage cover and discharges the CO_2 bottle on the raft. This system is completely automatic, requiring no human effort to launch the life rafts. It is also equipped with a manual release for disengaging the latches and discharging the raft CO_2 bottle. It is understood that this system has not been installed by the U.S. Army and Navy on American aircraft. This automatic system—including release valve, small cylinder, piston door release, and submersion actuator—weighs $9\frac{1}{2}$ lbs.

For the proposed use it is felt that it is inadvisable to use the submersion actuator. The unit depends on the aircraft's power supply, which is undesirable, and it also might be possible for the rafts to be launched, torn loose, and lost before the aircraft would come to rest. However, further data on experience with this system should be obtained before definite decisions can be made. It is believed that a manually operated cable release would be more satisfactory. This should be carried through the aircraft in tubing in such a manner that operating handles will be exposed at the emergency exits, the main cabin door, and on the flight deck.

Life Preservers

A life preserver to be useful must be extremely simple to put on and adjust, easy to inflate, lightweight for ease of handling and compact enough to be stowed at each seat. One of the most efficient life preservers is the Mae West. Because the Armed Forces use it as a general utility life vest, it has some features that could be eliminated for commercial use. It has been estimated that, if this vest were made of lightweight fabric such as nylon, if the rubber fabric coatings were reduced considerably (present coating is extremely heavy for rugged use), and if the crotch strap and abrasion pads were eliminated, the weight could be reduced to approximately 1.5 lbs. It should be as near self-adjusting as possible without undue complication. It would then also be compact enough so that it could be carried in a small container under the seat for accessibility.

It is also quite possible that other life vests will be developed that will be designed particularly for commercial use. More definite figures on the weight and stowed size of life preservers should be available in the near future, since several manufacturers are working with units that are expected to be suitable for commercial operation.

With regard to the stowage of life-preserver vests, estimates that have been given by several of the manufacturers to indicate that a vest as outlined above could be made which would fit into a cylindric container about 12 in. long and 3 in. in diameter. This container should be installed under each seat in such a way that it will be instantly available when required. Consideration should be given to providing a means for making quick inspection of such a unit.

Emergency Communication and Location Equipment

With regard to emergency communications equipment for future use, the A.A.F. and one of the aircraft radio manufacturers have developed a dual transmitter that is contained within the same case as the present SCR-578 emergency transmitter. This dual unit provides for transmission on both 500 kc. and 8,280 kc. It can, therefore, transmit distress signals on either the steamship distress frequency (500 kc.) or the recently assigned aircraft distress frequency (8,280 kc.).

For routes involving long overwater hops, it is highly desirable that great range be obtained, and therefore the high frequency transmission feature has been developed. Preliminary tests indicate that good D.F. bearings up to 1,000 miles are possible using transmission on 8,280 kc. Experience in North Atlantic communications, however, has indicated that such a high frequency may be useless at certain periods of magnetic disturbance or aurora borealis effects, and at such times the only frequencies that are useful are those of 500 kc. and below. For this reason, it is believed that the incorporation of both frequencies in one unit is essential, even though it might be possible to make a considerably lighter and more compact unit using high frequency only. It is the general opinion that the small receiver now carried on some A.T.C. operations is of importance in providing two-way contacts between rafts and rescue facilities.

Stowage

One of the biggest problems connected with the use of either the SCR-578 emergency transmitter or the new dual-frequency unit is the stowage space required for the accessory case. As previously mentioned, the accessory case occupies two-thirds (1,530 cu.in.) of the total volume (2,400 cu.in.) of the equipment and accounts for 17 lbs. or over half the total weight of the equipment.

In considering the packing of the emergency radio in a raft within a raft stowage, it can be seen that the bulk of such a unit, as this accessory container, greatly complicates the problem. It is therefore desirable that considerable thought be given to reducing such bulk as much as possible.

At the present time considerable work is being done on the use of radar for locating life rafts at sea. It is understood that the British have a compact unit weighing about 8 lbs., which is satisfactory for short-range work. Some work has been done in this field by various groups in both the Army and Navy. Results to date are encouraging, and military technicians have indicated that this general type of operation is the best possible way to locate life rafts, not only from the standpoint of minimum weight and bulk but also to obtain long-range accuracy of position. As of this date, little actual information is available because of military restrictions.

(*Continued on page 37*)

Table 2. Weight Comparison Between Existing Equipment and Anticipated Future Equipment, Based on Theoretical Aircraft Carrying 70 Persons, Including Crew.

NO REQ'D	ITEM	WEIGHT/EACH	GROUP WEIGHT	
	EXISTING EQUIPMENT			
10	TYPE E-2 RAFT (COMPLETE)	105	1050	
70	TYPE B-4 LIFEVEST	2.5	175	
1	TYPE SCR-578 EMERGENCY TRANSMITTER	34.0	34	
1	TYPE AVR-100 RECEIVER	7.0	7	
	(WT. PER PERSON = 18.0 LBS.)		1266	1266 LBS.
	ANTICIPATED EQUIPMENT			
2	20 MAN RAFT (COMPLETE)	110	220	
2	15 MAN RAFT (COMPLETE)	90	180	
70	LIFE PRESERVERS	1.5	105	
1	DUAL FREQUENCY TRANSMITTER	34	34	
1	TYPE AVR-100 RECEIVER	7	7	
	(WT PER PERSON = 7.8 LBS)		546	546 LBS.
	WEIGHT SAVED THROUGH USE OF ANTICIPATED EQUIP.			720 LBS.

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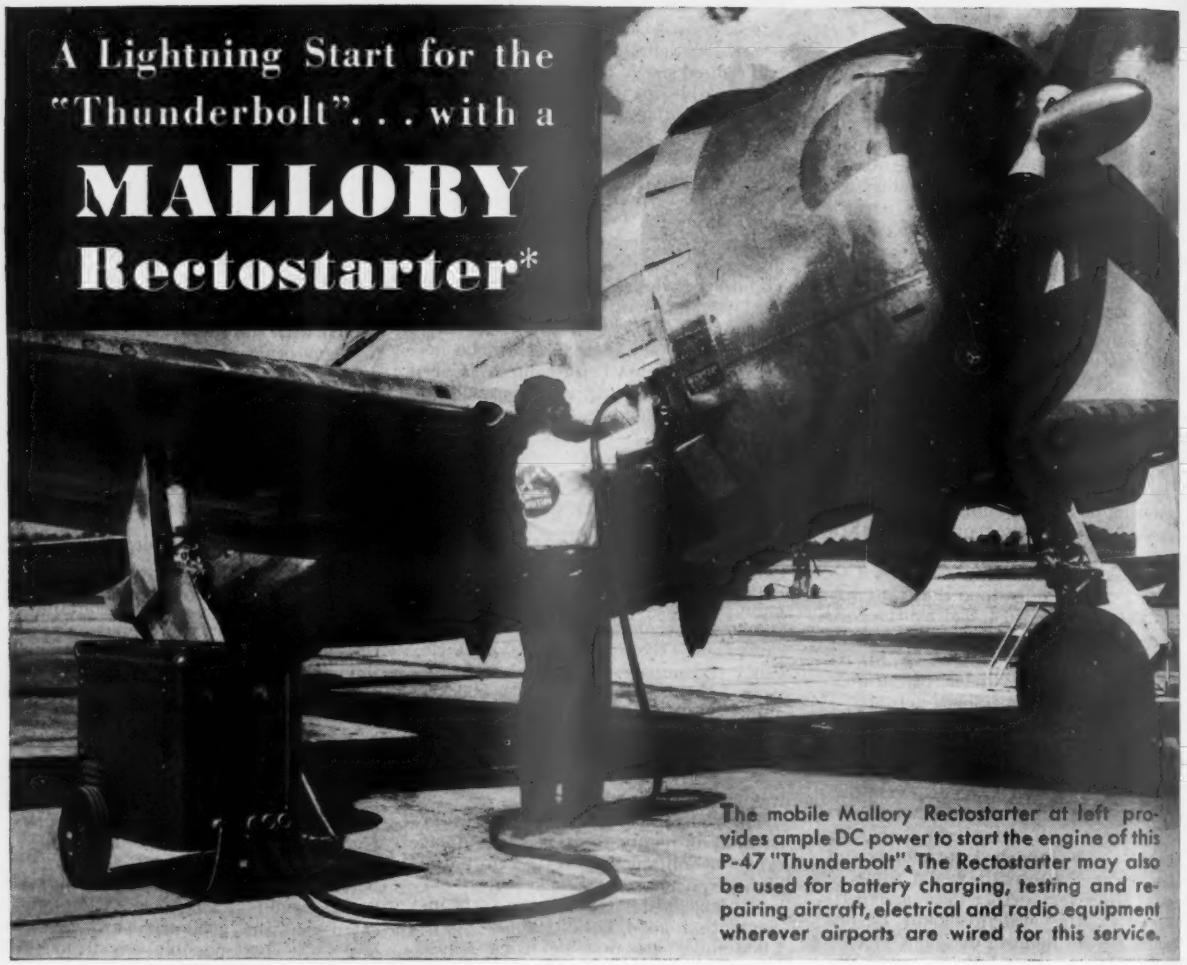

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Lighting Equipment for Adverse Weather Operations

WILBUR T. HARDING*
Wright Field

SYNOPSIS

Lighting equipment developed by the Army Air Forces is being utilized at advanced bases as an aid for operations, either day or night, under adverse weather conditions. Service experience with this equipment, which is described and illustrated, has been extremely favorable. The steps necessary to make this aid available for commercial operations are presented.

INTRODUCTION

THE SAFETY that is inherent in the operations of the present-day commercial air lines is well known to the traveling public. This safety of operation, however, is attained at the expense of regularity of operations. Flights are delayed, or canceled, because of weather conditions enroute or, more usually, weather conditions at the terminal airports.

Although the interruptions or delays to regularly scheduled flights on an annual basis may be less than 5 per cent, these irregularities in schedules should be reduced, since they are highly inconvenient to the traveler and costly to the air lines. It is not suggested that these irregularities be decreased at the expense of safety. It is suggested, however, that the problem be analyzed in an effort to correct this difficulty without impairing the safety record that now exists.

WEATHER LIMITATIONS

It is not the intent of this paper to consider weather conditions enroute. The solution of icing encountered under certain conditions is a separate problem not without solution. The weather at the proposed terminal, however, is a factor that must be considered. It is the major factor that contributes to the irregularity between present-day operations and the attainable ultimate.

Under present rulings air-line pilots are not allowed to attempt instrument landings unless they have a minimum ceiling. This minimum ceiling is usually around 300 ft. With proper equipment and suitable runways, safe landings at much lower ceilings are possible.

Presented at the National Air Transport Meeting, I.A.S., Washington, D.C., October 20, 1944.

* Major, Air Corps, Assistant Chief Electrical Branch, Equipment Laboratory.

RADIO AIDS

It is self-evident that radio aids are necessary. Without these aids existing schedules could not be maintained. There are some who feel that the entire problem of bringing in aircraft under restricted visibility conditions will be solved by instrument-landing equipment.

Instrument landings are at present accomplished either by using a standard let-down procedure on a radio-range station having a leg aligned on the instrument runway or by use of specialized instrument-approach equipment. With either type of equipment the pilot is directed along an approach aligned with the runway. Several factors affect the accuracy of the approach and alignment with the runway, such as instrument errors, instrument lag, pilot reaction, drift, and shift of the radio beams. If the landing is to be made upon a narrow runway, the landing cannot be completed using instruments alone without some hazard because of these inaccuracies. In addition to this common deficiency, there are other factors to be considered for each system.

(a) The use of a standard let-down procedure on a radio-range station handicaps the pilot under certain wind conditions. In addition, the rate of descent must be checked by indicated altitude at two or three points during the approach. In other words, the pilot must govern the approach so as to pass over each marker beacon at specified altitudes. The system, however, has the advantage of requiring no additional radio receivers in the aircraft.

(b) The use of specialized instrument-approach equipment gives a constant check on the rate of descent and has the further advantage that the runway used need not be aligned with a leg of the radio-range station. The use of this system, however, necessitates approximately 35 lbs. of additional receivers in the airplane. These receivers are relatively simple and reliable in operation and their signals are readily interpreted.

LIGHTING AIDS

If it is assumed that the radio aid utilized will bring the pilot along the proper path to the runway and that the approach has appreciable errors in connection with the alignment to the centerline of the runway, then additional aids that will allow a normal contact landing are required. For this application lights especially designed for the purpose are available and are proving their usefulness. For this application the lights and lighting system should comply with the following general requirements:

(a) The lights must be effective during periods of low visibility, either day or night.

(b) The system utilized should be arranged so as to allow the pilot to transfer from instruments to lighting aid in sufficient time to make a normal contact landing.

(c) During extremely adverse weather conditions, the lights should be designed to produce the maximum practicable signal so that the pilot may discern the lights and correct his alignment for landing.

(d) During favorable weather conditions, the intensity of the lights should be reduced in order to avoid glare.

(e) Stray light must be reduced to a minimum. It is evident that an intense signal must be directed along the path that the pilot normally approaches. Unless the light is restricted to these essential angles, stray light will illuminate fog or rain particles with the result that while the pilot can see the first lights those farther away will be blanketed out by a lighted fog curtain.

(f) The lighting system must be arranged so that the pilot will know exactly where he is with respect to the runway.

Expanding upon these general requirements, it should be noted that to be effective either day or night under adverse weather the use of conventional contact lights is precluded. Further, even the most optimistic lighting engi-

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neer realizes that the range of lighting equipment under adverse weather is limited, and, under the worst conditions, ranges exceeding 800–1,000 ft. will not be realized. If this is true, the pilot has to make his alignment and landing from observation of a limited number of lights. It is evident that lights along the runway arranged similarly to conventional contact lights would be used. Augmenting these lights, additional units marking the approaches are necessary.

In connection with the approach zone, a path 2,000 ft. or longer should be provided. This will enable the pilot, when making a proper instrument approach, to anticipate the light signals on reaching the inner marker beacon or shortly thereafter. All lights, either approach or runway, should be spaced not over 200 ft. (100 ft. preferably) apart along the rows.

With respect to the design of the lighting unit, there are several factors that make the use of an incandescent unit preferable. The requirements that a high intense signal be directed in the approach angles, that the stray light be reduced to a minimum, and that the intensity be controllable would eliminate other types particularly gaseous tube units.

Historical Background

The general requirements outlined above were determined approximately 6 years ago. At that time it was anticipated that the lighting system would utilize special lighting units, called approach lights, to mark the approach path to the end of the runway. These lights would act as lead-in lights to the conventional contact lights along the runway. At that time the installation of lights extending higher than 3 in. above ground level would not be approved by operating personnel. That restriction frankly delayed progress.

In the early part of 1943 the Army Air Forces conducted a comparative test between an incandescent and a neon installation. The results of this test confirmed the advantages of the special incandescent units. The most significant fact, however, was that during the test the incandescent units were installed along the runway and used for runway lights. These units, extending approximately 24 in. above ground level, were not considered as appreciable obstructions.

During the summer of 1943 units of the same type were installed at a Naval Air Station in Newfoundland. This installation utilized only runway lights, since the runway ended at water's edge. A group of Army and Naval personnel participated in test flights using radio aids in making the approach. The purpose of the test was to ascertain whether or not the lighting units would be of assistance under low visibility conditions. *Tests were made during daytime with extremely low ceilings, with restricted visibility, and with the fog "boiling" out of the ground and obscuring the runway. From these tests it was evident that the lights were a definite aid and indicated the runway position, allowing a last-minute realignment necessary for a safe landing. It was also evident that without the lights safe landings would have been impossible.*

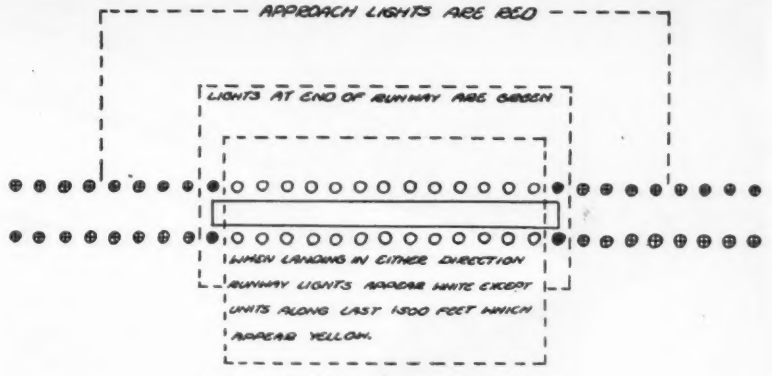
APPROACH LIGHTS ARE RED
LIGHTS AT END OF RUNWAY ARE GREEN
WHEN LANDING IN EITHER DIRECTION
RUNWAY LIGHTS ARRAGE WHITE EXCEPT
UNITS ALONG LAST 1500 FEET WHICH
APPEAR YELLOW.

Fig. 1. High-intensity lighting systems.

Following these tests, the Army and Navy embarked upon a consolidated production program. The initial installations were made at northern bases where sudden changes of weather prevailed and where alternates were not often available. From service reports from these stations there is no doubt that this equipment has permitted operations during weather conditions that otherwise would not have been feasible.

Installation Features

In planning an installation for instrument approaches under adverse weather conditions there are many factors to be considered. The most important are as follows:

(a) Select a runway that will avoid cross-wind or downwind landings of an appreciable magnitude.

(b) Select a runway that has clear approaches at both ends so that landings can be made from either direction.

(c) Radio aids for approaches are mandatory.

The proper lighting installation should have the following general features:

(a) The lights along the runway should be placed along the edge of the heavy-duty paving.

(b) Approach zones extending at least 2,000 ft. from the end of the runway should be marked with lights.

(c) The lights along the runway and in the approach zones should form two continuous rows with the rows preferably not over 300 ft. apart.

(d) The lights should be spaced not over 200 ft. apart along the rows.

(e) The lights in the approach zone should serve as lead-in lights to the end of the runway and should mark the minimum level at which a plane may safely fly and avoid obstructions.

(f) The minimum requirements with respect to light distribution of the light are covered by Army Air Forces Specification 32429.

A general plan view of a desirable installation is shown by Fig. 1. This plan illustrates a runway with an approach zone at each end. A color sequence standardized by the Army, Navy and Civil Aeronautics Administration utilizes color as follows:

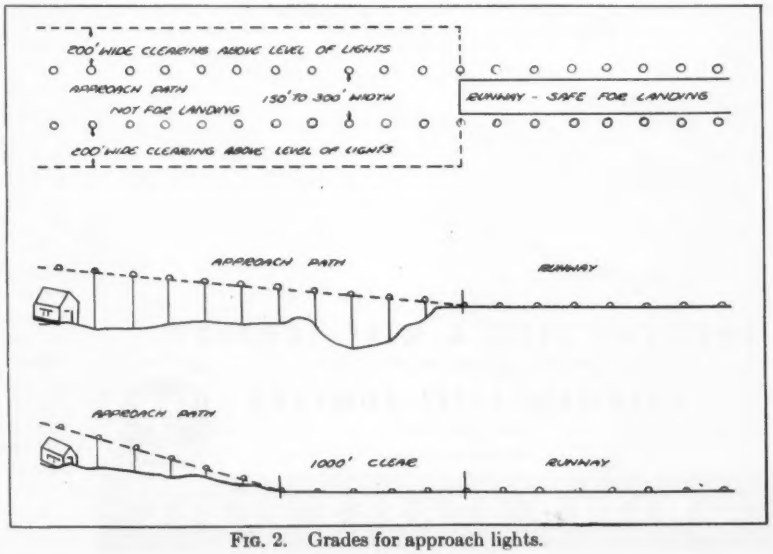

Fig. 2. Grades for approach lights.

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Main subjects covered comprise—Aircraft Control Cables; Cold Rolled Strip Steel; U·S·S Stainless Steel; Wire—stitching, spring, and special wire for aircraft construction and maintenance; Cold Finished Steel Bars and Springs.

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For information beyond that covered in these pages, the assistance of our many offices and laboratories is at your service.

Because of restrictions imposed by war conditions we are unable to offer this manual for general distribution, but if you are a chief engineer, project engineer, superintendent in charge of engineering, or hold similar executive office in the aviation industry, a copy will be sent you upon request on your company letterhead. Copies are also available for library use of aircraft manufacturing companies.

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Cleveland, Chicago and New York
COLUMBIA STEEL COMPANY
San Francisco
United States Steel Export Company, New York

USS STEEL

UNITED STATES STEEL

Red —Approach zones
Green —Marks ends of runway
Clear —Marks first portion of runway
Yellow—Marks last 1,500 ft. of runway

Fig. 2 shows the two arrangements of the elevations of the approach lights. It should be noted that the lights are inclined to clear obstructions. One arrangement inclines the lights to the end of the runway. The other arrangement, which is preferable, inclines the lights to a point approximately 1,000 ft. from the end of the runway.

Equipment

The lighting unit that was used for installation at northern bases is similar to those illustrated by Figs. 3 and 4. This unit uses a series lamp of approximately 200 watts as a light source. The special lighting distribution is obtained by an inner and outer glass lens. Color is obtained by glass color filters placed between the two lenses. Fig. 5 shows a typical installation in which the light is placed directly upon the ground. With this installation the light extends approximately 24 in. above ground level.

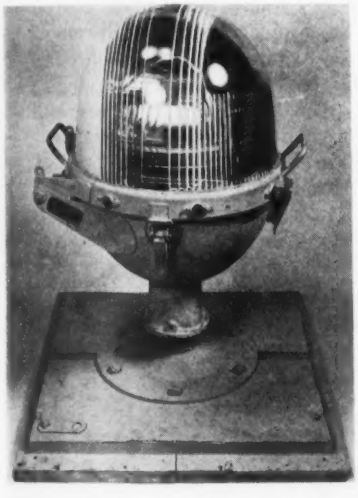


Fig. 3. High-intensity light—exterior.

Fig. 4. High-intensity light—interior

Fig. 5. Aligning lights at northern base.

In order that the intensity of the lights may be varied depending upon weather conditions, a special series regulator, as shown in Fig. 6, was utilized. This regulator when connected to commercial power (or a special power plant) energizes a series circuit normally at 6.6 amp. This corresponds to full intensity or 100 per cent light output. By means of a manually operated tap changer, the intensity may be varied to produce a light output of 100, 30, 10, 3, or 1 per cent normal as desired. For the worst weather conditions the 100 per cent setting is used. For fair-weather operation at night the 1 per cent setting would be selected.

Conclusions

There are a number of significant facts which can be drawn from the experiences of the military services using this new equipment for adverse weather. These facts have been mentioned previously but are reassembled for further examination as they represent a radical departure from previous practices.

(a) The proper correlation of radio aids and lighting aids upon a suitable instrument approach runway is a basic requirement for adverse weather operations.

(b) Neither the radio aid nor the lighting aid in itself is sufficient, even though the runway is satisfactory.

(c) The lighting equipment now used at commercial airfields is entirely inadequate for adverse weather operations.

(d) Lighting equipment that will give valuable assistance *either day or night* under adverse weather conditions is being used and has been proved by the military services.

(e) Lighting equipment extending as high as 24 in. above ground level is being used at advanced and permanent military bases. The hazard is considered negligible. The equipment is being used to land aircraft returning from missions with battle damage and wounded personnel during which the airplane is not completely under control.

(f) Lighting installations for our future airports should be designed for the worst weather conditions and should be used at reduced intensities for more favorable weather.

Our Future Advancement

It is the opinion of the writer that an improvement in our air transport service can be accomplished by decreasing or eliminating entirely the interruptions to regularly scheduled flights. This must be done without a decrease in safety. It can be done if a constructive program is planned and placed in operation. This program can be realized. The steps necessary are as follows:

(a) Improve existing air terminals or establish new ones so that sufficient runways suitable for instrument approaches are available for essential wind conditions.

(b) Install complete radio aids on each instrument-approach runway for each approach.

(*Continued on page 145*)

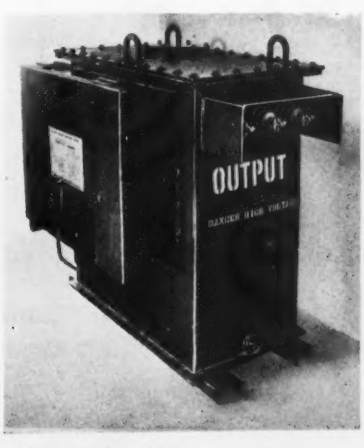
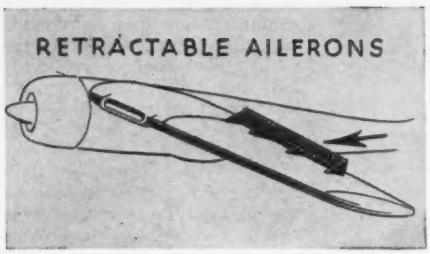
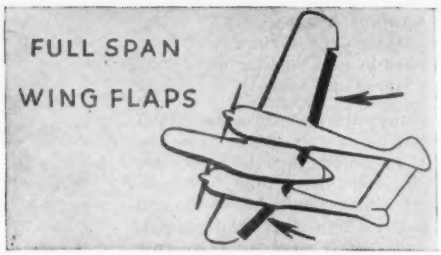


Fig. 6. Regulator for intensity control of lights.



PERMIT



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Structural Design Problems of Light Aircraft*

STANFORD J. STELLE†

Civil Aeronautics Administration

Introduction

The C.A.A. War Training Service, formerly the C.A.A. Civilian Pilot Training Service, has been operating a fleet of several thousand light commercial airplanes of from 50 to 450 hp. on an intensive pilot training program for civilians and for the Army and the Navy. Up to the present, approximately 11,000,000 hours of instruction have been given.

The airplanes were originally operated at approximately 600 flight centers, but since the advent of the war these centers have been reduced to some 300. They are uniformly distributed throughout the entire United States, a natural result of which is that operation has been from fields ranging from sea level to over 6,500 ft. and under all climatic conditions.

Continuous year-round operation has been a necessity in order to meet schedules of the Army and Navy; consequently, operation has been carried on under all weather conditions. Many airports utilized had no paved runways or adequate hangar and shop facilities. While such a condition is not conducive to long life of airplanes, it tends to bring out quickly any inherent weaknesses.

The fleet of airplanes has been subject to rigid standards of maintenance and operation set up by the Aircraft and Flight Equipment Division, War Training Service, and administered by maintenance supervisors in the field.

Maintenance supervisors regularly visit each flight training operation and furnish the Regional and Washington Office of War Training Service with Inspection Report Forms made on each airplane approximately every 30 days and with Chronic Mechanical Difficulties Reports when chronic, unusual, or dangerous conditions are encountered on airplanes during inspection. These latter reports contain an accurate description of each difficulty and, for the purpose of clarification, pertinent sketches or drawings.

It is the purpose of this paper to point out some of the difficulties encountered with operation and maintenance of the present-day light airplane of between 50 to 75 hp. as revealed by review of reports submitted. It will stress the difficulties now being encountered, so that in designing the light airplane of the future these difficulties may be guarded against. It has been said that if the doctor can determine the patient's ailments, he can more readily prescribe a remedy. In the case of the airplane, the engineer and scientist will necessarily prescribe the cure.

In some instances, suggestions will be made as to the possible methods that might be employed to eliminate reported difficulties. However, in the main, the difficulties will merely be pointed out to serve as a challenge to engineers.

Safe operation of an airplane now demands that a daily inspection be performed. This inspection generally takes the form as outlined on C.A.A. War Training Service Form ACA-526. A review of this form shows the items that generally give trouble. Engineers and scientists should make every effort to design light airplanes that do not need such daily time-consuming and tedious inspections to make them safe for operation.

Presented below, by components, is a résumé of the most prominent difficulties.

Propellers and Propeller Hubs

Propellers and hubs in use in the training program have given comparatively little trouble; however, some difficulties have been reported.

Several times the thin trailing-edge sections have been cracked or broken out during hand-cranking operations. This has generally been brought about by rings worn on the fingers of the person cranking.

Screws or rivets holding metal leading edges have often become unsoldered and have loosened.

Blades have shifted in metal tipping, leaving a small portion of the blades adjacent to tipping exposed to weather because of the absence of protective covering.

Wearing down of protective coatings with admission of moisture has probably been responsible for certain lamination separations. Deeper penetration of protective coatings may eliminate such a condition and greatly prolong propeller life.

Propeller hub flanges have been found cracked through lightening holes, and some flanges have a tendency to bow out with consequent distortion between bolt locations.

Splits across the face extending from bolt holes have been reported as being caused by wood shrinkage.

Engine Mounts

One major siege of mount cracking was experienced during operation of the fleet of airplanes, and such failures were attributable to a design that allowed strain to be localized at a particular point in the mount. Design should be such that cracking will be eliminated in the future. Also, in designing mounts, full consideration should be given to vibration absorption characteristics.

Cowling

While little major difficulty has been experienced with cowling, certain minor points should be emphasized.

Often, anchoring methods have proved unsatisfactory insofar as ease of removal and installation are concerned. Fasteners of the peg and pin type possess poor appearance and poor streamline characteristics and, in addition, have been responsible for many cuts to the hands of airplane cleaners. Also, removable pins are easily lost. Tools are generally required to fasten and unfasten other types of fasteners, and alignment and fastening of some installations are often difficult. Likewise, replacement of such fasteners when worn is often a difficult task.

Certain trunk lock fasteners are difficult to operate when the peg over which the bail fits is not secured against being pulled inside and in back of the bail and lever section.

Cracking of cowling at edges where flexing is encountered and at openings can seemingly be overcome only with adequate beading and support and by careful ground handling.

Insecurely fastened and inadequate abrasion strips cause an appreciable amount of unnecessary cowl and structure wear.

Fire Wall

Little need be said of this component with the exception of pointing out the

Presented at the National Light Aircraft Meeting, I.A.S., Detroit, April 27–28, 1944.

* Observations are those of the author and do not necessarily represent the views of the Civil Aeronautics Administration.

† Chief, Aircraft and Flight Equipment Division.

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necessity for properly aligned holes for tubing and wiring and for properly fitted and adequate grommets. Solvents used in cleaning have a tendency to deteriorate rubber grommets rapidly, and it would be well if a permanent system for protecting lines and wires could be devised. By doing this there would be one less item to check during routine inspections.

Cockpit

Difficulties with the cockpit of the average light trainer-type airplanes have been reported and are summarized as follows:

The cockpit is often "too full" when occupied by two persons in winter flying togs.

The seemingly simple problem of providing a resting place for the feet has proved troublesome. If no provision is made for heel scuff plates, floorboards rapidly wear beneath rudder pedals, and if plates are present, difficulty has been experienced with their anchorage, resulting in heels being jammed beneath the plates and the rudder pedals.

In some instances anchorage of rugs or mats is a troublesome problem because of placement of fasteners where it is possible for them to be stepped on and damaged. Fraying of mats and rugs at all cutouts has been particularly noticeable on certain types of the light airplanes. However, such a condition is not serious insofar as safety is concerned.

When repairs to structure in the cockpit must be made and interior fabric is necessarily removed, it has been found that great difficulty is experienced with replacing the covering. The method presently utilized for anchorage in the majority of cases is a "onetime proposition."

Weight cost of fabrication and size of cockpit is a most important consideration. Thought devoted to design of seats would probably reduce pilot and passenger fatigue and would preclude the possibility of seat-back breakage as has been reported. Seats no heavier than the present ones may be a result of careful design. In certain models of airplanes seat-back breakage is thought to be the result of use of the back as an "assist" in entering and leaving the rear seat of certain tandem models, thus imposing strain that the seat back was not designed to withstand.

Map and logbook holders as generally provided have proved to be inadequate and unable to withstand long usage. Seemingly little thought has been given to provision for displaying license and registration papers.

While in the majority of cases the fire-extinguisher location and anchorage problem has been partially overcome, a few reports indicate cases where, in rough air, extinguishers have loosened and have either struck the pilot or temporarily jammed controls. An ideal situation would exist when the fire extinguisher is secure but readily removable and is anchored in a position where it would be easily accessible to both pilot and passenger or student.

If first-aid kits were mounted in plain view in an adequate holder located in a position least susceptible to being covered by structure in the event of "crack up," much would be accomplished.

There have been many reports regarding engine controls within the cockpit. The average light airplane contains no provision for throttle quadrant friction plates, and creeping throttles have resulted in difficulties being experienced by students. Control markings explaining function and operation have proved to be unsatisfactory. A pilot unfamiliar with a particular airplane would be greatly aided if markings were such that they had remained legible and bright. Marks placed on upholstery or fabric in close proximity to controls have, during repair, been eliminated by patching or refinishing of such material and have often not been reinstalled. In designing any airplane expected to be used as a trainer, thought should be given to accessibility of controls to both pilot and student when securely held in place by safety belts. In one model only the occupant of the front seat is able to reach the carburetor heat control. This airplane was placarded "solo flight from rear seat only." Under such conditions, heat could not be applied by solo students.

Some difficulty has also been reported with "do not exceed" markings painted on the glass faces of certain instruments in the cockpit. Faces have revolved and have accordingly changed the position of these markings. In such a condition an inexperienced student may possibly turn his engine to an incorrectly marked point and, while flying, be in a nearly stalled attitude.

During the training program it has been brought out that stabilizer or tab indicating devices on the average light airplane are prone to give false readings and are generally of such flimsy design as to be comparatively short-lived. Then, too, it has been proved that the actuating mechanism of the control itself has in many cases been a source of difficulty.

Undoubtedly, cockpit heaters have been designed with the sole thought in mind that the airplanes would be used only in the mildest of weather. Because of generally poor fitting inclosures, it is impossible for pilot and passenger to stay warm without the use of heavy flying suits. These are not conducive to comfort or quick action on the part of pilot or student. It is possible that some type of satisfactory independent heating system with outlets at both seats could be devised for the light airplanes.

Difficulties with windshields, skylights, and inclosures have repeatedly been reported. The most common difficulty seems to be the short life of the transparent material due, on one hand, to the effect of hot sunlight and, on the other, to rapid change of temperature. Sunlight rapidly discolors, checks, and makes brittle certain materials now commonly in use, and in numerous cases certain materials have cracked when an airplane was moved from a heated hangar directly out into severely cold atmosphere.

With plastic research, undoubtedly there will evolve material that, if correctly installed, will remain usable for a longer time than is the case at present. In all events, ample provision is not being made at present for expansion and contraction of the various materials now in use.

Windshields

In designing windshields, thought should be given to providing a simple, quick method of removal and reinstallation without the necessity of drilling out old rivets and installing new ones. Also, a windshield with curves and contours should be designed so that objects seen through it will not appear distorted.

Prominent among difficulties with inclosures are those connected with scratching when pieces of transparent material must slide by each other or into a recess. The majority of slide channels are such that sliding is difficult, and the spacing of these channels is such that rubbing of material and consequent scratching is prevalent. There have been several reports of side inclosure material being blown out because of the flimsy nature of its anchorage.

The C.A.A. War Training Service is a great believer in retaining any feature designed to aid visibility, and in no instance has permission been granted to remove skylights built into the airplane by the manufacturers. It is realized, however, that such a practice has been costly to operators because of the maintenance difficulty. In the first place, anchorage is not adequate and sufficient to last for long periods of time, and, in the second place, transparent material generally utilized is comparatively short-lived. Flight characteristics are slightly changed when the edges of the skylight are not securely fastened and are drastically changed when skylights blow out. Consequently, operators must keep these items in good condition at all times.

In the interest of safety and ease of maintenance, many requests have been received for permission to substitute fabric for transparent material in the top of fuselages. Such requests have implied that these skylights are of little value as a safety measure, since pilots and students rarely use them for their intended purpose. While it is probable that the majority of pilots do not direct their glances at regular intervals through the skylights, it is certain that any movement by an airplane overhead would soon attract attention, and it is probable that in many instances a warning of a nearby airplane has been given by its shadow crossing the skylight. Steps that may be taken to improve the skylight situation most certainly should not take the form of its removal from the light airplane.

Safety belts have come in for their share of minor criticism. Their place-

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ment and material is generally such that they readily accumulate dirt and grease and transmit them to the laps of wearers. Also, if left untied at an unoccupied seat, they may foul controls. It would be well if designers could do the thinking for pilots in this latter respect and provide a means whereby belts would be precluded from hanging loose if the pilot neglects to tie them across unoccupied seats.

Fuselage

Practice has proved that the average fuselage is capable of withstanding normal stresses. However, in student training, abnormal landings have often damaged fuselages, particularly in the vicinity of the landing gear. While it is known that "beefing up" members at this location is generally not the answer, it would be well if manufacturers would realize the possibility of such a condition and make provision for access to this vulnerable spot so that repairs could be adequately and easily made without affecting appearance.

Thought should also be given to designing fuselages so that recover work done outside of the factory would not result in bent and bowed longerons between braces.

It is generally difficult to inspect and work on the extreme tail end of the average light-plane fuselage. This fact, coupled with inadequate drain provision, is probably responsible for tubes in this section being rusty and the section being dirty. Airplanes would last much longer if provision could be made for elimination of the possibility of water standing along longerons.

Provision of a tail tie-down ring on the fuselage, as well as tail-lifting lugs or handles, would prove extremely valuable. Secure anchorage and elimination of much fabric damage would result.

Fabric has been damaged in many instances where metal fairing edges have vibrated and have cut into adjacent material. Securely installed antiabrasion material would overcome this situation.

Wings

Wing leading edges on certain models have received their share of comment from maintenance supervisors. Isolated reports of leading edge collapse have been received. Design is probably not wholly at fault in such cases. However, in some instances, more thought devoted to protective covering and design that did not rely solely on glue and nails might have precluded failure for a much longer period of time.

Several reports have described a condition where flexing of wings have caused sharp sides of metal leading edges to bow and cut wing fabric. It would be well if designers could make provision for "bumping out" metal leading edges in the event they become dented. The unsatisfactory practice of drilling and inserting a metal screw in order to pull out a dent must generally be resorted to at present.

Inadequate and, in some cases, poorly placed drain holes have resulted in internal wing damage from standing water. It would be well if a type that would not easily be plugged by dirt were devised.

The majority of spar difficulties have arisen as a result of operation in arid regions. Longitudinal cracks in the vicinity of plywood reinforcing plates have been reported in many cases. The consensus is that the cracks are brought about by drying of the spar, resultant shrinkage being resisted by the plywood plates that do not shrink in proportion. The cracks usually start at a bolt hole and spread until they extend beyond the plate to a point where resistance of the plates to shrinking is not present. It has been found that a cracking condition is more prevalent in spars carrying comparatively thick plates opposite each other. Little tendency to crack has been noted when plates are installed on only one side of the spar. Undoubtedly, thought should be given to impregnating wooden spars with a protective material that would have a tendency to retain the correct moisture content for long periods of time within the spar.

While good practices demand that wing tip bows not be used as lifting points, such is not often the case, and a bow whose anchorage at the spar ends has been loosened is one that is comparatively difficult to repair because of the amount of undamaged spar material left to work with. Accordingly, bow anchorage should come in for its share of thought.

Some day there will be devised a wing that does not require a "major operation" when a spar is cracked or broken.

Control System

Abrasion is the greatest enemy of the control system, and any steps that can be taken to reduce abrasion would be reflected in longer life of the various items making up the system.

Cables are generally used for the transmission of forces to move the various controls. They serve a most important function and must be continuously checked to insure safe operation. Undoubtedly, periods between inspections could be greatly lengthened if thought were given to alignment and decrease of friction where direction of cables must be changed. It would be well if the system could be designed so that cables would run straight from the central control levers to the surfaces to be actuated. In this way, internal friction of the various strands of the cable itself and rubbing over pulleys and guides would be cut to a minimum. However, if pulleys must be used, they should be of a type that is easily turned because numerous reports indicate that they are prone to freeze either against their brackets or in their bearings. When this happens, abnormal cable wear results along with abnormal pulley wear due to flattening. The best pulleys should be used, and particular attention should be given to insure that guides are not used to change cable direction in those places in the airplane that are difficult to inspect, such as under floorboards, inside the rear end of the fuselage, and inside the wings.

Cable difficulties have also been reported in cases where installations cause the pilot's shoes to rub against the cables when working the rudder pedals. Also, fabric rubbing against cables where they enter or leave the fuselage or wing has a particularly detrimental effect on the cable itself.

It has been found that heavy strain is often put on the section of cable which links the front and back pedals of the tandem-type airplanes by instructors "taking away" control from students. Such a factor should be considered during design of the airplane.

Distortion of turnbuckle forks has been reported in cases where control stops have worn to the extent that it is possible for the control horn to reach the position that it bears against the top of the U of the fork. In addition, worn control stops have been responsible for "violent" performance in certain maneuvers by permitting excess control surface travel. Thought should be given to making such stops incapable of rapid wear or shifting.

Stabilizer or tab-adjustment mechanismsare subject to rapid wear and bending on certain models of airplanes. Design should provide for long periods of trouble-free operation of this item.

It is wondered if thought has ever been given to using a hydraulic system of control actuation on the light airplane. Through such a system few working parts would be between the central control column and the control surfaces.

Control Surfaces

With the exception of reported rapid wear of hinges and hinge pins, little difficulty has been experienced with the control surfaces themselves. The advent of grit and dirt has been responsible for rapid wear in hinges and pins, and covering or sheathing is probably the most expeditious manner in which the condition may be overcome.

On certain models in use in the training program, no provision, other than the possibility of changing pins, is made for overcoming looseness that develops through wear. When new pins do not remove looseness, it is necessary to replace the fittings themselves. (This is a tedious and involved procedure.)

Of course, the old "bug-a-boo" of holes in the underside of elevators and stabilizers has been present during the training program, and one hesitates to suggest a rock guard for overcoming this situation.

Fabric

While little or no major difficulty has been experienced with the present-day,

light-airplane fabric, certain minor items should be pointed out.

Possibly some thought should be given to installation of "dams" at strategic spots on the fuselage. Several instances are known where, once started in flight by the lifting of a skylight or a side window, large sections of fabric have been blown away. The advisability of installing tape across certain sections of the fuselage should be considered. Such procedure might prove valuable along the bottom of the fuselage where oil and grease, possibly coupled with a slight amount of battery acid, may make fabric comparatively weak.

Some criticism has been directed against certain color schemes presently in use. While all pains should be taken to make combat planes as invisible as possible, on the other hand, training and commercial planes should be painted in such a manner that they may easily be seen, no matter over which color terrain they may be flying. An airplane painted like a peppermint stick may not be the most beautiful one, but it is possible that its pilot will enjoy a safe existence.

Gasoline Systems

Chafing against support straps and leakage at corner seams have occasionally been reported as difficulties with fuel tanks.

Another difficulty has been that fittings in the bottom of certain tanks have extended up into the tanks and have tended to trap and hold water along the tank bottoms. Corrosion has been a natural result.

Gascolators have come in for their share of criticism, and the majority of this has been directed toward the method of sealing the glass bowl against the metal top. It would be well if there could be designed a gascolator that did not require the gasket method of sealing, since frequent removal results in the frequent need for new gaskets or may lead to use of a sealing compound with its resultant possibility of restricting gasoline flow.

Why has not someone as yet devised a gascolator that may be readily adapted to the light airplane and which provides a practical method of safeguarding the bowl against unloosening? Wiring a knurled nut to a slanting bail so that the nut cannot move is a task for a magician.

One wonders also how many airplanes are flying this day with the standing screw at the bottom of the gascolator bale in a bent and distorted and, consequently, weakened condition. No gascolator bowl—no power!

Several accidents have been reported because failure to lock certain types of primer pumps after use has resulted in raw gasoline being sucked into cylinders during glides with the power off. The average student has quite a "handful" at best, and it would be well if such procedure were one about which he did not have to worry.

Landing Gear

Frequent replacement of landing gear bushings has been necessary during the program, and, while thanks have been given for the possibility of eliminating looseness by merely changing bushings on the average landing gear, this necessity should occur at less frequent intervals. Ample grease fittings or sealed bearings might aid in this. The adoption of the automotive practice of rubber suspension might be beneficial.

Slide tubes generally employed in shock-cord-type landing gears have, in several instances, become distorted and rapidly worn. Some type of soft "bumper" at travel end and some type of bearing that provides for alignment and elimination of rubbing of one tube against another might go far in overcoming this situation.

Dust and dirt, the bane of oleo struts, may be precluded from accomplishing its work by provision being made for some type of sheathing.

Use of hydraulic brake systems on the majority of light airplanes has resulted in little difficulty with this component. However, several accidents are reportedly attributable to water, picked up while taxiing, freezing between the brake shoes and drums and locking the wheels.

Tire anchorage to wheels has caused some difficulty when air pressure in tires has been allowed to fall below requirements. In such cases, valve stems have been pulled from tubes upon application of brakes. This, of course, would never have happened had correct pressure been maintained; but normal operation practices, be they good or bad, must be considered if a trouble-free airplane is to be designed.

Research concerning tail shock assembly may, in the future, lead to development of a trouble-free unit. Reports indicate that, when springs are "beefed up" sufficiently to preclude breakage, damage is caused to fuselage structure. The lesser of two evils is to allow the springs to break.

Engines

The horizontally opposed engines, such as the air frames, have as a general rule performed their task splendidly. Reports, however, have revealed certain difficulties that are enumerated by component. In all probability, mention of these will act as a stimulus for improvement.

Idling

By far the greatest number of reported malfunctionings have been in respect to idling, the difficulty resulting in engine stoppage during closed or reduced throttle operations such as in practice during glides, practice spins, power-off stalls or other closed throttle operations. Operation instructions have been released on the subject and have had their effect on reducing this trouble. The human element, however, plays a large part in such instructions, and the problem is still present in a large measure.

Perhaps the most common operational cause is improper idling adjustment of the carburetor. Difficulty here is probably chargeable to maintenance.

Dirt and dust in idling passages have been found to be common causes of failure. Consideration should probably be given to the use of air filters or to relocation of air-intake positions in an endeavor to overcome this situation.

Loose carburetor shaft bushings and insecure carburetor mounting have been responsible for engine stoppage during idling. In either case, mixture is affected. Design, insofar as anchorage is concerned, is in all probability not at fault; however, rapid wear at shaft ends is something that may be overcome on the drawing board. In a few cases stoppage during idling has been attributed to ignition, but this has not been a chronic contributor.

Lack of proper temperature of oil and engine has been a major contributor to idling difficulty both from the standpoint of friction within the engine and the effect upon proper mixture of air and gasoline. In some localities merely closing off cowl openings has not had the desired effect, and lagging, in addition, must be applied. This is difficult to accomplish in a safe, workman-like manner on the average small engine. There should be some other way of bringing engines up to proper operating temperatures and maintaining them at that temperature.

"Loading up" and stopping during glides can easily be precluded by proper throttle manipulation, but redesign could automatically overcome such a tendency.

Rapid throttle opening on the small engines results in disturbance of fuel-air ratio and may cause engine failure when the weight of the propeller will not allow it to "flywheel" for any protracted length of time. An accelerating pump would probably overcome this situation. However, it would add weight and cost. Possibly the situation could be overcome in another manner.

The effect of ice in the carburetor venturi is such that engine stoppage while idling is prevalent. Proper operation of controls now provided in the average light airplane will preclude engine failure from this cause, but the necessity for such operation imposes another duty upon the pilot. All indications point to the fact that, if all other conditions are satisfactory, idling difficulty from ice can be precluded by application of heat prior to closing of the throttle and when the engine is still delivering a comparatively large amount of heat. Could not there be devised an automatic "genius" that would know when the pilot planned to close his throttle and that would, approximately 2 min. prior to this time, "pull on" the carburetor heat?

Crankshaft

Crankshaft failures have occurred but such failures cannot be classed as chronic. The failures have occurred

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through crankpins, throws, and at propeller ends. It is possible that more attention to design and finish would result in overcoming nearly all of such failures in the future. Studies have indicated the possibility that breakage in some cases has been due to strain localization in unfinished portions of the shafts, and other failures are believed to be caused by lack of provision for sufficient radius of fillets at corners.

There are two schools of thought on the subject of sludge plugs. Some believe their value is overcome by the possible chance that they will not be removed and cleaned during major overhaul of the engine. Reports indicate that occasionally they are not cleaned and resultant damage has ensued.

Valves

The most vulnerable spot on exhaust valves is at the stem near the head. A study to eliminate breakage should probe into whether or not forging defects, light design, overheating, improper spring arrangement, or a combination of two or three of these is the contributing cause. Intake valves have generally broken at the cir-clip grooves near the end of the valve stem. Improperly fitting valve spring locks, sharp lock groove corners, material, clearance in guides, and valve springs should be considered when steps are taken to eliminate breakage.

Cylinder Heads

Cylinder-head failures have not been extensive. When they have occurred, the finger of suspicion has been pointed at detonation and consequent overheating caused either by poor fuel or by advent of excess air, such as would be admitted through carburetors being loose on their mounting flanges, by looseness in throttle shaft bushings, by insecure primer connections, or by improperly fitting intake pipes and glands. Undoubtedly, to overcome such failure completely the engines should be designed to run on comparatively poor fuel, and steps should be taken to insure that none of the other contributing factors could be present.

Crankcases

In many instances crankcases have been found to be cracked both on those engines with cylinders cast integral with the case and on those that have separate cylinders. Two factors contributed to the failures—design that permitted strain to be localized and poor fabrication processes.

Spark Plugs

Comparatively few reports on faulty operation of spark plugs are on hand, but it is believed that the majority of such difficulties are not reported. Cracked insulation, loosened center electrodes, and fouling are common complaints. It is realized that the plug alone is not solely responsible for all of these evils, but it would be well if there could be worked out a combination of engine magneto and plug which would insure trouble-free operation of these items for the normal period between engine overhauls.

Breathers

Serious trouble has been reported in certain cases where crankcase breather lines have been routed to exhaust into the carburetor intake. The purpose of this was to insure a clean installation. However, practice has proved that the cold air in the vicinity of the intake will often freeze the condensate present in the breather line, and the line will become completely plugged with ice. This results in high crankcase pressures being built up. Likewise, venting of moisture-laden air into the carburetor has had the same effect as spraying water from a garden hose into the venturi of the carburetor. This is conducive to rapid ice formation during cold weather. In all probability there will be designed a trap that will catch crankcase vapors and also preclude stoppage of the vent.

Miscellaneous

A seemingly minor difficulty, but one that has resulted in damage to certain types of engines, is the chain normally used to preclude loss of oil filler neck caps. These chains normally hang inside the neck, and links have been broken, have fallen into tanks, and have been circulated along with cold oil until they have reached the oil pump gears, causing damage to the gears or shaft.

Conclusion

It may reasonably be that if the difficulties outlined above are overcome in future light airplanes, these airplanes will cost a fortune, and, because of weight, will be limited to running down some well-paved highway. It is hoped, however, that such will not be the case and that there will be devised ways and means to produce low cost, well-performing, trouble-free light airplanes. The present ones are good—future ones will be better.

(*Continued from page 19*)

The best place for the stowage of the emergency communication or location equipment is, as previously stated, within a raft in a raft stowage. The great bulk of the SCR-578 and dual frequency transmitters may, however, prevent this, and therefore a separate stowage compartment may be necessary. If such is necessary, provisions should be made for the ejection of the emergency radio unit at the same time that the rafts are ejected from the raft stowages. In either case the radio unit should be attached to one of the life rafts to prevent its loss during launching of equipment.

Standardization

To give some idea of the weight-savings alone which can be anticipated using the proposed lightweight equipment, let it again be assumed that equipment is required for an aircraft carrying 70 persons, including crew (see Table 2). Using the proposed equipment, two 15-man and two 20-man rafts with accessories, plus 70 life preservers and the emergency radio unit, would total 546 lbs. or 7.8 lbs. per person aboard. This compares with a total of 1,266 lbs. or 18.0 lbs. per person which would be required if the best of existing equipment were to be used. The 720 lbs. that could be saved becomes a large factor in the operations of such an aircraft over long overwater hops. It also means that only four rafts would have to be launched instead of having to launch ten units with the resulting confusion.

Since accommodation of the raft stowage in the design of the aircraft is so desirable, it is felt that emergency equipment should be standardized. Rather than having each carrier submit a separate equipment layout for approval, one agency should draw up a set of specifications for the benefit of all carriers. Such a set of specifications should not only cover the material and construction of each item but should also specify the amount required on board on the basis of the total personnel to be carried. The method of stowage should also be specified, standardizing it as much as possible. A plan such as this would have many benefits: it would permit the carrier to allow for a definite weight and balance factor, both in his recommendations to the aircraft manufacturer and in his operations, and it would concentrate work and thought regarding such equipment in one agency, thus saving duplication of effort.

Such standardization has been brought to the attention of officials of the Civil Aeronautics Board and the Civil Aeronautics Administration. Both agencies feel that such standardization would be highly desirable. Both agencies also have suggested that the Air Transport Association assume the function of standardization, with the resultant findings being the basis of recommendations to the Civil Aeronautics Board. Consequently, the matter was recently brought to the attention of the Engineering Division of the Air Transport Association.

At the present time, many of the large aircraft for use in overwater operation are in the design stage or approaching that point. If suitable emergency equipment is to be accommodated in the design of such aircraft, little time can be lost in its development. It, therefore, becomes a matter that deserves the immediate attention of all interested carriers, since every pound saved in this equipment is available as a pound of revenue-producing pay load.

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Institute News

Institute Honors and Awards

The presentation of The Thurman H. Bane Award for 1944 was announced in the December issue of the REVIEW. The John Jeffries Award for 1944 (announced in the October issue of the REVIEW) and the following awards were presented to the recipients at an Honors Night Meeting held on January 31 in the Engineering Societies' Auditorium in New York. The presentation of The John Jeffries Award to Air Marshal Sir Harold E. Whittingham was made by Major Gen. David N. W. Grant, The Air Surgeon, U.S. Army Air Forces.

A detailed account of the presentations will appear in the March issue of the REVIEW.

Honorary Fellowships Presented to Sir Frederick Handley Page and Edward P. Warner

Honorary Fellows of the Institute are elected by the Honorary Fellows and Fellows of the Institute residing in the United States. It is one of the highest honors the Institute confers upon persons of pre-eminence in aeronautics. Not more than one Honorary Fellow residing in the United States nor more than one Honorary Fellow residing in a foreign country may be elected in any one year.

Honorary Fellowship was given to Sir Frederick Handley Page, Managing Director of Handley Page Ltd. and Vice-Chairman of the Air Registration Board. Dr. J. C. Hunsaker, Chairman of the National Advisory Committee for Aeronautics, made the presentation, and Col. Sir Vivian Gabriel, British Air Commission, accepted the Honorary Fellowship for Sir Frederick.

Sir Frederick Handley Page.

Sir Frederick was born in Cheltenham, England, November 15, 1885. He was educated at the Finsbury Technical School and was trained as an electrical engineer. While Chief Designer to Johnson and Philips of Charlton, England, in 1906, he became interested in aviation. To test his ideas, he made a number of model gliders with the cooperation of José Weiss.

In June, 1909, he founded Handley Page Ltd., and in the same year built the monoplane "Bluebird," his first machine. He also built an experimental biplane. In 1912 the firm moved to Cricklewood and engaged in war work during World War I.

Up to the outbreak of the first World War practically all experimentation was devoted to producing an inherently stable airplane, and shortly after the end of the war Sir Frederick developed the Handley Page slot, which has been widely adopted.

At the end of World War I, he was made a Commander of The Order of The British Empire. He is an officer of The Order of The Crown of Belgium, is a Fellow and Past-President of The Royal Aeronautical Society, and has served on many important aviation committees. In 1930, he was appointed Chairman of the Society of British Aircraft Constructors.

Edward P. Warner, Vice-Chairman of the Civil Aeronautics Board, was presented with an Honorary Fellowship in the Institute by Mr. T. P. Wright, Civil Aeronautics Administrator.

Mr. Warner was born in Pittsburgh, Pa., November 8, 1894. His formal education includes the degree of B.A. from Harvard in 1916 and the degree of B.S. in 1917. He also received the degree of B.S. from the Massachusetts Institute of Technology in 1917 and an M.S. degree from the same school in 1919. In 1938 he was awarded the honorary degree of D.Sc. from Norwich University.

During Mr. Warner's distinguished career in aeronautics, he has been associated with the U.S. Army, Navy, and other Government departments, as well as State and Municipal Aeronautical Boards. He was Chief Physicist of the National Advisory Committee for Aeronautics, 1919–1920, and was Technical Attaché for the N.A.C.A. in Europe in 1920. At intermittent periods from 1918 to 1924, he was associated with the Massachusetts Institute of Technology and was Professor of Aeronautical Engineering from 1924 to 1926. He was Assistant Secretary of the Navy for Aeronautics, 1926–1929, Editor of *Aviation* magazine, 1929–1934; and Vice-Chairman of the Federal Aviation Commission, 1934–1935. He has been a member of the Civil Aeronautics Board since 1939.

Edward P. Warner.

Mr. Warner is a member of the leading engineering societies of the United States and an Honorary Fellow of The Royal Aeronautical Society. He was awarded the medal of the Aero Club of France in 1927 and was the recipient of the Wright Medal in 1932. In 1943 he delivered the Wilbur Wright Memorial Lecture before The Royal Aeronautical Society in London.

Recently, he was a member of The American Delegation to the International Civil Aviation Congress held in Chicago.

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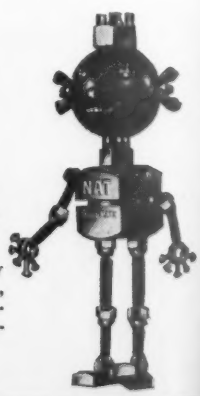

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Fellowships of the Institute

Fellows of the Institute are proposed and elected by Honorary Fellows and Fellows of the Institute residing in the United States. It is required that a Fellow shall have attained a position of distinction in aeronautics and shall have made notable and valuable contributions in one of the aeronautical sciences or aeronautical engineering. Not more than 10 Fellows residing in the United States and 10 Fellows residing in foreign countries may be elected each year.

The following 10 Associate Fellows of the Institute were elected Fellows: John D. Akerman, Professor and Head of the Department of Aeronautical Engineering, University of Minnesota; Paul S. Baker, Engineering Manager, Chance Vought Aircraft Division, United Aircraft Corporation; Charles Froesch, Chief Engineer, Eastern Air Lines, Inc.; Alexander Kartveli, Vice-President and Chief Engineer, Republic Aircraft Corporation; Otto E. Kirchner, Chief Engineer, American Airlines, Inc.; W. Randolph Lovelace, II, Lt. Col. Medical Corps, Aero Medical Laboratory, Engineering Division, U.S. Army Air Forces, Air Technical Service Command, Wright Field; Erle Martin, Engineering Manager, Hamilton Standard Propellers Division, United Aircraft Corporation; Shatswell Ober, Associate Professor of Aeronautical Engineering, Massachusetts Institute of Technology; Leonard E. Root, Chief Aerodynamicist, El Segundo Plant, Douglas Aircraft Company, Inc.; Selden B. Spangler, Capt. U.S. Navy, Engineering Duty, Power Plant Design Section, Bureau of Aeronautics, Navy Department.

The Sylvanus Albert Reed Award

Fred E. Weick, Chief Engineer of the Engineering and Research Corporation, was selected to receive The Sylvanus Albert Reed Award for 1944, which is given annually by the Institute of the Aeronautical Sciences in recognition of a notable contribution to Aeronautical Engineering. It was endowed in 1933 through a bequest of $10,000 by the late Dr. S. A. Reed.

Fred E. Weick.

The award was presented to Mr. Weick by Dr. George W. Lewis, Director of Aeronautical Research of the National Advisory Committee for Aeronautics.

Mr. Weick was educated at the Armour Institute of Technology and the University of Illinois, receiving his B.S. degree in 1922. In 1922 he was associated with the U.S. Air Mail Service, and from 1924 to 1925 he was with the Bureau of Aeronautics of the U.S. Navy Department as a designer of propellers. He joined the N.A.C.A. in 1925 and left in 1929 to become Chief Engineer of the Hamilton Aero Manufacturing Co. In 1930 he again became associated with the N.A.C.A. as Assistant Chief of Aerodynamics and held this position until 1936. Since 1936 he has been Chief Engineer of the Engineering and Research Corporation. He is a Fellow of the Institute.

Col. Benjamin S. Kelsey.

The Octave Chanute Award

Col. Benjamin S. Kelsey of the U.S. Army Air Forces was chosen to receive The Octave Chanute Award for 1944, given annually for notable contributions made by a pilot to the aeronautical sciences.

The Award honors the memory of the American engineer, Octave Chanute, who died in 1910. He was a pioneer in aeronautical research and gave assistance and advice to the Wright Brothers in their early work.

As Colonel Kelsey was unable to be present at the meeting, the award was accepted for him by Col. Paul H. Kemmer, U.S. Army Air Forces. The Award was presented by A. Lewis MacClain, Installation Liasion Engineer of the Pratt and Whitney Aircraft Division, United Aircraft Corporation, recipient of The Octave Chanute Award for 1942.

Colonel Kelsey was educated at the Massachusetts Institute of Technology and specialized in mechanical engineering. He was graduated with the degree of B.S. in 1928 and took graduate work from October of that year to June, 1929, after which he entered the Air Corps as a flying cadet. He returned to Massachusetts Institute of Technology in February, 1932, for further study and to receive his M.S. degree. He is a graduate of the Air Corps Primary Flying School and received the rating of airplane pilot upon graduation from the Advanced Flying School at Kelly Field, Tex., in October, 1930.

In his experimental work at Wright Field associated with flight testing, Colonel Kelsey secured valuable test data regarding compressibility.

The Robert M. Losey Award

John Cary Bellamy, Special Consultant of the Army Air Forces Weather Service, was the recipient of The Robert M. Losey Award for 1944.

The Award was established by the Institute in 1940 in honor of the memory of Capt. Robert Moffatt Losey, an American officer in the Air Corps who was killed in Norway on April 21, 1940, while serving as an official meteorologic observer for the U.S. Army. He was the first United States officer killed in World War II. The Losey Award is made in recognition of outstanding contributions to the science of meteorology as applied to aeronautics.

As Mr. Bellamy is at present on duty in the Pacific theater, the Award was received for him by Dr. Horace R. Byers of the Department of Meteorology, University of Chicago. The Award was presented by Dr. F. W. Reichelderfer, Chief of the U.S. Weather Bureau.

Mr. Bellamy was graduated from the University of Wisconsin in 1936 and took a Masters degree in physics at the University of Wyoming in 1938. In 1942 he completed a brief course in meteorology at the University of Chicago. In addition to his formal education, he completed the C.A.A.-C.P.T. training course. In 1943 he became instructor and head of the radiosonde laboratory and was in charge of the mobile weather

John Cary Bellamy.

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Non-Magnetic Properties

Three of the high-nickel alloys are non-magnetic at sub-zero temperatures. (See Table).

Consideration of non-magnetic characteristics along with strength and ductility turns the spotlight immediately on **"K" Monel. This alloy can be age-hardened and will remain non-magnetic to as low as −150° F. Severe** cold work and age hardening do not change its non-magnetic characteristics.

A typical application is in the Sperry Horizon Instrument. Here the *combined* strength, ductility, corrosion-resistance and non-magnetic properties of "K" Monel single it out as the ideal material for long, accurate service.

* * *

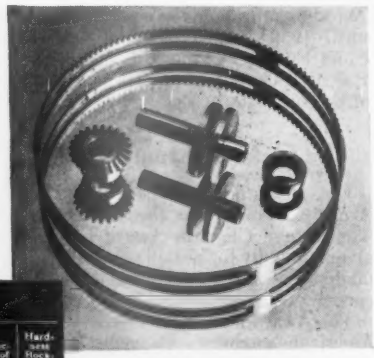
For further information regarding the properties and working of INCO Nickel Alloys, write for a copy of the booklet "INCO Nickel Alloys for the Aircraft Industry." A copy is yours for the asking. Address:

Magnetic Properties

Material	Magnetic Transformation Temperature (Curie Point) F at Permeability of 1.02 max	Permeability at Room Temperature H=1 Oersted	Permeability at Room Temperature H=200 Oersted
"K" Monel	minus 150	less than 1.02	1.001
"H" Monel	minus 70	less than 1.02	1.005
Inconel	minus 40	less than 1.02	1.005
Monel	110-190	25	15
Nickel	680	120	30
Iron	1410	5000	100

Summary of Effect of Low Temperatures on Nickel and High-Nickel Alloys

Increase with Decreasing Temperature	Remain Unchanged with Decreasing Temperature	Decrease with Decreasing Temperature
Tensile strength Yield strength Proof stress Proportional limit Tensile modulus Torsional modulus Brinell hardness Torque (or for a given load) Elongation	Reduction of area Impact strength	Length



PARTS FOR SPERRY HORIZON INSTRUMENT. Tough, strong, *non-magnetic* "K" Monel assures accuracy... longer life. These parts are machined soft, then heat-treated for maximum strength and hardness.

Mechanical Properties at Low Temperatures*

Material	Condition	Temperature °F	Yield Strength (0.2% offset) psi.	Tensile Strength psi.	Elongation in 2 in. per cent	Reduction of Area per cent	Hardness Rockwell C.
Monel	Cold-drawn	Room	93,500	103,800	19.8	71.8	19
	Cold-drawn	−110	100,850	117,450	21.8	70.2	25
	Cold-drawn	Room†	93,300	103,400	17.3	72.5	21
Nickel	Cold-drawn	Room	97,400	103,400	16.3	66.9	19
	Cold-drawn	−110	101,900	110,300	21.3	60.8	22
	Cold-drawn	Room†	95,750	102,700	16.3	69.2	20
Inconel	Annealed	Room	36,800	93,800	37.3	64.1	82B
	Annealed	−110	42,400	106,850	39.8	64.0	87B
	Annealed	Room†	36,200	93,000	38.5	64.4	82B
	Cold-drawn‡	Room	147,700	152,100	7.0	49.3	31
	Cold-drawn‡	−110	154,900	163,900	7.8	51.2	34
	Cold-drawn‡	Room†	147,400	151,900	7.3	49.3	32
"K" Monel	Cold-drawn, age-hardened	Room	125,900	157,300	15.5	37.4	33
	Cold-drawn, age-hardened	−110	134,600	171,350	17.3	41.1	38
	Cold-drawn, age-hardened	Room†	125,800	157,350	14.8	37.2	33

*Bureau of Standards Report, June 14, 1937.
†Cooled to and held at −110° F. for several hours prior to testing at room temperature.
‡50 per cent reduction in cross-sectional area by cold drawing.

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL ST., NEW YORK 5, N. Y.

unit of the Department of Meteorology of the University of Chicago. He held this position until December, 1943, at which time he became Director of the Institute of Tropical Meteorology of the University of Puerto Rico.

Among his other duties he became instructor in tropical meteorology for Army Air Forces Weather Officers and Naval Ensigns. He is at present an Army Air Forces Special Weather Consultant in the Pacific theater. Mr. Bellamy has made numerous published contributions to the science of weather forecasting.

The Lawrence Sperry Award

William H. Phillips was chosen to receive The Lawrence Sperry Award for 1944. It is given annually for a notable contribution made by a young man to the advancement of aeronautics.

The Sperry Award, established by the Institute in 1936, is endowed by the sister and brothers of the late Lawrence Sperry, pioneer aviator and inventor, who met death by drowning at the age of 31 as the result of a forced landing in the English Channel in 1923.

The award was presented by Col. E. E. Aldrin of the U.S. Army Air Forces.

Mr. Phillips is a graduate of the Massachusetts Institute of Technology and received his M.S. degree in aeronautical engineering in 1940.

In June, 1940, he joined the N.A.C.A. as an aeronautical engineer, conducting flight tests on stability problems. As Head of the Stability and Control Flight Test Section at Langley Field, he has directed the work of all project engineering, including stability and control tests of new airplanes.

Honorary Memberships

Honorary Memberships in the Institute were conferred upon Brig. Gen. F. O. Carroll, Chief of the Engineering Division of the Air Technical Service Command, U.S. Army Air Forces; Major Gen. Clements McMullen, Air Technical Service Command, U.S. Army Air Forces; Capt. J. Laurence Pritchard, Secretary, The Royal Aeronautical Society; Brig. Gen. Eugen G. Reinartz, President, Aero Medical Association; and Dr. C. G. Rossby, President, American Meteorological Society.

Gifts to the Aeronautical Archives

Dr. Otto Kallir gave a painting, "Then and Now," by Max Rimboeck, which he received as the Zeppelin-Eckener Award at the Berlin International Mail Exhibition in 1930 for his studies in air-mail transportation. With this gift Dr. Kallir presented a certificate of the award, aeronautical menus, and 284 air-stamp labels.

The Central Aircraft Corporation, through the courtesy of H. Murray Semple, gave a model of an all-wing

William H. Phillips.

semitailless transport airplane, designed by Vincent J. Burnelli. A model of the Grumman F6F Hellcat Navy fighter airplane and an aeronautical calendar were received from the Grumman Aircraft Engineering Corporation through the courtesy of Roger Wolfe Kahn. A section of a propeller blade from a Japanese bomber shot down over Pelelieu Island was received from Lt. Col. Eric W. Wood.

The Waterbury Button Company, through the courtesy of Peary Cohen, gave 14 aeronautical uniform buttons. Capt. G. H. Robinson, of Barksdale Field, La., gave an insigne of the French Air Force Squadron and a photograph. An album of records, "Songs of the Fighting Allies," was received from the Longines-Wittnauer Watch Company through the courtesy of John P. V. Heinmuller. The British Fleet Air Arm gave 36 Fleet Air Arm insignia through Lt. J. P. M. Reid. A 16-mm. Kodachrome sound film, *The Lightning P-38*, was received from the Lockheed Aircraft Corporation. The Globe Aircraft Corporation gave its insignia and publications. The Royal Aeronautical Society sent two books: *H. G. Hawker, Airman*, by Muriel Hawker, London, 1922, and *Amateur Pilot*, by the Earl of Cardigan, London, 1933.

George A. Maag gave ten *Technical Notes* and 29 *Technical Memorandums* of the National Advisory Committee for Aeronautics. The Ranger Aircraft Engines Division of the Fairchild Engine and Airplane Corporation sent 66 issues of aeronautical periodicals. Miss Dorothy Monro sent aeronautical periodicals and 40 newspaper and magazine clippings. The Propeller Division of the Curtiss-Wright Corporation gave 80 issues of technical periodicals. The Eclipse-Pioneer Division of Bendix Aviation Corporation added more than 500 issues of technical periodicals to its previous gifts. The Aeronautical Digest Publishing Corporation gave 106 issues of foreign aeronautical periodicals. The bound first volume of *International Aviation* was received from American Aviation Associates through the courtesy of Wayne W. Parrish.

Applications, exhibits, and briefs relating to proceedings on new air routes before the Civil Aeronautics Board were received from Airdrome Transport, Alaska Airlines, Inc., American Export Airlines, Inc., Atlantic Gulf and West Indies Steamship Lines, Burlington Transportation Company, B. & W. Lines, Inc., Checker Taxi Company of Boston, Chicago & Southern Air Lines, Inc., Dayton & Western Ohio Airlines, Inc., Des Moines Flying Service, Inc., Duncan Air Transport, Eagle Airlines, Inc., William Filene's Sons Company, Frisco Transportation Company, Frontier Airways, Inc., Globe Aircraft Corporation, Grace Lines, Inc., W. R. Grace & Company, Greyhound Skyways, Inc., William Edward Hann, Humboldt Air Lines, International Airways, Inc., Lehigh Aircraft Company, E. R. Leonard, Lone Star Airways, Inc., Massey & Ransom Flying Service, Inc., Matson Navigation Company, Mid-Continent Airlines, Inc., Moore-McCormack Lines, Inc., North Central Airlines, Pan American Airways, Inc., Parks Air Transport, Inc., Penn-Ohio Coach Lines Company, Pennsylvania-Central Airlines Corporation, Piedmont Aviation, Inc., J. E. G. Rogers Limited, Royal Dutch Air Lines, Royal Netherlands Indies Airways, Service Stages, Inc., Southern Airways, Inc., Sky Harbor Ludwig Airport, Skyway Corporation, Spartan Airlines, Inc., Texas Bus Lines, Transcontinental & Western Air, Inc., Trans-Oceanic Air Lines, Inc., U.N. Airships, Inc., Van Meter, Streeter & Company, Vermont Transit Company, Inc., and Ray Wilson, Inc.

Other gifts were received from the Cleveland Aviation Club, Eastern Aircraft Division of General Motors Corporation, Edo Aircraft Corporation, Jordan Air & Suction Pump Company, Laister-Kauffmann Aircraft Corporation, New York Municipal Airport Kiwanis Club, Polish Information Center, Schweizer Aircraft Corporation, U.S. Army Air Forces Training Division, Civil Aeronautics Board, and Office of War Information.

New Corporate Member

Dzus Fastener Company, Inc., Babylon, N.Y., has recently become a Corporate Member of the Institute. The company was incorporated under the laws of the State of New York in 1936 and succeeded an unincorporated enterprise known as the Dzus Fastener Company, which was founded by William Dzus in the year 1932.

The principal business of the company is the manufacture of the Dzus Fastener, which is widely used throughout the aircraft industry. The device, used as a cowl fastener, was invented by the founder and President of the company.

During the war period the company has carried out an expansion program to meet the greatly increased demands of the armed forces.

Institute Officers for 1945

W. A. M. Burden, *Vice-President.*

Leroy R. Grumman, *Vice-President.*

I. M. Laddon, *Vice-President.*

Officers of the Institute for 1945 have been elected by the Council as follows:

President—CHARLES H. COLVIN.

Vice-Presidents—W. A. M. BURDEN, Assistant Secretary of Commerce; LEROY R. GRUMMAN, President, Grumman Aircraft Engineering Corporation; I. M. LADDON, Executive Vice-President, Consolidated Vultee Aircraft Corporation; and ARTHUR E. RAYMOND, Vice-President in Charge of Engineering, Douglas Aircraft Company, Inc.

Charles H. Colvin, *President.*

Treasurer—EARL D. OSBORN, President, Edo Aircraft Corporation.

Chairman of the Council—LESTER D. GARDNER.

Administrative Committee—BENNETT H. HORCHLER, Executive Vice-President; GEORGE R. FORMAN, Assistant to the President; ROBERT R. DEXTER, Secretary; JOSEPH J. MAITAN, Controller.

Members of the Advisory Board for 1945 and new members of the Council will be announced in the March issue of the REVIEW.

Arthur E. Raymond, *Vice-President.*

Earl D. Osborn, *Treasurer.*

Lester D. Gardner, *Chairman of the Council.*

Bennett H. Horchler,
Executive Vice-President.

Corporate Member Changes Name

Aircraft Accessories Corporation, a Corporate Member of the Institute, has changed its name to Aireon Manufacturing Company.

Sections and Branches

Buffalo Section

The third meeting of the 1944–1945 program of the Buffalo Section was a technical meeting, held on October 24 at the Hotel Lafayette. Dr. H. V. Hawkins presided and opened the session with the announcement of the tentative acceptance of an invitation by the Institute for a joint meeting with the Society for Experimental Stress Analysis to be held May 16–19 at the Hotel Statler. Papers that might be presented at such a meeting were mentioned. The revised constitution of the Buffalo Section, as received from the headquarters of the Institute, was referred to the Constitution Committee for action. In a report of the Meetings and Papers Committee, Paul Hovgaard outlined the program for the next meeting.

Dr. Hawkins introduced Donald Douglas, Jr., of Douglas Aircraft Company, Inc., who spoke on the problems of flight testing at the Douglas plants.

Paul Hovgaard introduced Charles Hathorn who gave an illustrated review of the evolution of the metal propeller.

On November 22, the fourth meeting of the 1944–1945 program was held at the Hotel Westbrook, with Chairman Hawkins presiding. He read an invitation to attend a meeting of the Joint Engineering Committee for Niagara Frontier. It was voted that the Chairman and an appointed member attend the meeting, which was held on November 27, and report at the next meeting what had been learned about the exact functions of the Joint Engineering Committee.

Stephen B. Elggren, of Bell Aircraft Corporation, gave a report of the Meetings and Papers Committee, including suggestions for possible speakers for future meetings.

The Constitution Committee was requested to prepare its report for the January meeting, and it was announced that a committee would be appointed to cooperate with the headquarters of the Institute with regard to the joint meeting to be held in Buffalo with the Society for Experimental Stress Analysis on May 16–19.

The first speaker of the evening was John Luttrell, who was introduced by the Secretary, John B. Scalzi. Mr. Luttrell spoke on "The Advantages of Local Air Services." His talk was illustrated with charts and diagrams of the cost of operation, proposed routes, and schedules.

The second speaker was Dr. V. Markovin, of Bell Aircraft Corporation, who was introduced by Joseph I. Robinson, also of Bell Aircraft Corporation. Dr. Markovin lectured on compressibility, outlining the information currently available and suggesting means of determining factors that still are not fully known. The speakers answered questions during the discussion periods following their talks.

Robert R. Dexter, *Secretary.*

Cleveland Section

A meeting of the Cleveland Section was held on November 28 at the Airplane Engine Research Laboratory Auditorium of the National Advisory Committee for Aeronautics. Willson Hunter, Vice-Chairman, presided in the absence of the Chairman. The meeting was attended by 76 members and guests. The speaker was Dr. E. A. Stalker, formerly head of the Aeronautical Engineering Department of the University of Michigan and now associated with The Dow Chemical Company. His topic was "Problems of the Helicopter," which was followed by discussion dealing with the limitations of the helicopter and various features of some present designs.

At a meeting on December 19, the Cleveland Section had as guest John

George R. Forman,
Assistant to the President.

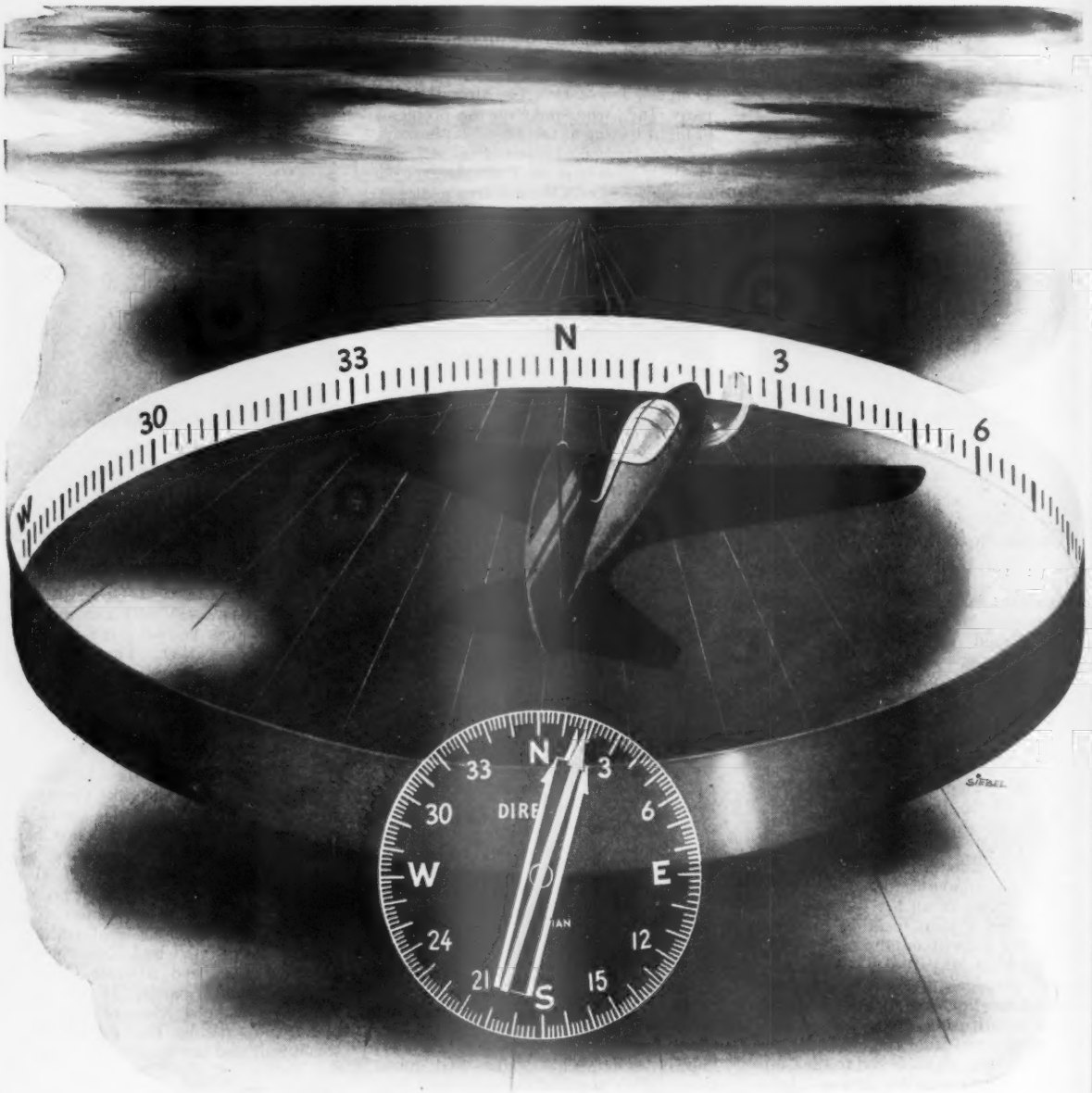
Stack, Chief of the Compressibility Research Division, Langley Memorial Aeronautical Laboratory, National Advisory Committee for Aeronautics. He repeated the Eighth Wright Brothers Lecture, "Compressible Flows in Aeronautics," which he had given in Washington 2 days earlier. There were 400 members and guests in attendance at the meeting.

Los Angeles Section

A dinner meeting of the Los Angeles Section was held at the Elks Temple on November 30. Philip A. Colman, of Lockheed Aircraft Corporation, Chairman of the Program Committee, presided and introduced Major R. H. Fleet, President of the Institute, who discussed the progress being made with regard to a building for the local section.

C. L. Johnson, Chief Research Engineer of Lockheed Aircraft Corporation, presented a paper, "Development of the Lockheed Constellation Airplane," discussing the aerodynamic, structural, and mechanical problems in the design of the Constellation and their solution. The development of the

Joseph J. Maitan, *Controller.*



FLIGHT-LIKE INDICATION is the characteristic of the Kollsman Direction Indicator which makes it so well liked by many pilots. All of the points in azimuth are visible at all times, reading clockwise as on the compass rose of a navigation chart. A distinctive memo pointer may be set to the desired course so that any deviation is immediately apparent. The pilot merely keeps the pointers matched. These features make the instrument easy to read, easy to follow. Excellent performance characteristics also aid the flyer. The Direction Indicator is self-contained and fits the standard compass mounting, requiring only a light connection.

KOLLSMAN AIRCRAFT INSTRUMENTS

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power-boost control system was also reviewed. Two hundred and seventy-three members attended the meeting.

New York Section

A meeting of the New York Section was held on January 5, 1945, at the McGraw-Hill Building auditorium. One hundred and seventy-five members of the Institute were present.

Dr. Ludwig G. Lederer, Medical Director of Pennsylvania-Central Airlines Corporation, presented a paper titled "Certain Aspects of Aviation Medicine."

By special permission of the U.S. Navy, two films were shown: *This Is It* and *Leapfrogging*.

Because the paper by Dr. Lederer and both of the motion-picture films were restricted material, the meeting was limited to Institute members only.

Texas Section

A meeting of the Texas Section was held December 7 in the Texas Hotel at Fort Worth. The guest speaker was O. R. Hoeltzer, Process Engineer of the Fort Worth Division of Consolidated Vultee Aircraft Corporation, who spoke on "Applications of Plastics in Aircraft."

Following this paper, a motion picture about plastics was shown through the courtesy of Formica Insulation Company. A brief discussion closed the meeting.

Aeronautical University

No meeting was held during the month of December by the Aeronautical University Branch. Discussion of forthcoming activities was postponed for consideration at the January meeting. Because the Secretary expected to be called to active service in the armed forces, the election of a new Secretary was also scheduled for the next meeting.

University of Alabama

A business meeting of the University of Alabama Branch was held on December 7 with 23 members in attendance; Chairman Robert E. Williams presided. Colgan H. Bryant, Faculty Adviser, spoke on "Why Join the Institute of the Aeronautical Sciences?" It was voted that Freshmen and Sophomores be admitted to membership in the Branch, but with limited privileges.

The following officers were elected: Chairman, Robert E. Williams; Vice-Chairman, William K. Rey; Secretary-Treasurer, Herman E. Sewell, Jr.

University of Cincinnati

Meetings of the University of Cincinnati Branch were omitted in December because all aeronautical engineering students were engaged in the cooperative work-section plan and were away from college. They returned to their studies during the second week of January.

Georgia School of Technology

A technical meeting of the Georgia Tech Branch on November 13 was attended by between 30 and 40 members. D. W. Hutton, Director of Aeronautics at the School, gave a talk on "The History of the Helicopter," which was accompanied by lantern slides.

At the technical meeting on December 11, 80 members and guests gathered to hear a talk on "Rockets" by Willy Ley, the widely known specialist in rockets and reaction propulsion. An invitation was extended to all branches of engineering societies at the School to attend this meeting. All business matters were omitted.

A special meeting was held on December 12 at which the Bell Aircraft Corporation motion-picture film *Cannon on Wings* was shown. Twenty members attended.

Illinois Institute of Technology

The Student Branch held a business meeting on December 13, with Chairman Mayster presiding. Plans were discussed for a trip to the Chicago aircraft-engine plant of the Dodge Division of Chrysler Corporation. Detailed information concerning the Institute was given to new members at the meeting.

A technical meeting held on December 19 was attended by 17 members. The motion picture *Fortress in the Sky* was exhibited, showing the Boeing B-17 in action.

Indiana Technical College

W. H. Schock, Jr., presided at a business meeting held on December 8. The following officers were elected: Chairman, J. Lee Burk, Jr.; Vice-Chairman, Allison Caudill; Secretary-Treasurer, James A. Weber.

Iowa State College

A combined technical and business meeting took place on December 14, at which John Ryken presided and 20 members attended. Lieutenant Colonel Johnston of the Army Air Forces gave a talk on "Lightplanes as Cargo Carriers."

John A. Guggendohl was elected Junior Representative to the Engineering Council.

University of Kansas

With an attendance of 14 members, a combined technical and business meeting was held on January 11. D. R. Learned presided. A committee was appointed to meet with representatives of other engineering societies to plan a joint social affair.

The motion picture *Target for Tonight* was exhibited.

Massachusetts Institute of Technology

The M.I.T. Branch held a technical meeting on December 21, with an attendance of 100. The film *Building the PBY Record Breakers* was shown.

New York University

Prof. Frederick K. Teichmann presided at a business meeting of the New York University Branch on December 8. The Branch was reorganized at that meeting, and the following officers were elected for the remainder of the present term and the next term: Chairman, William Bruning; Vice-Chairman, Matthew Miller; Secretary-Treasurer, Donald Eli Witkin. Professor Teichmann was unanimously elected Honorary Chairman of the Branch.

Twenty-five members attended a technical meeting on December 15. A National Advisory Committee for Aeronautics film was projected, showing combustion taking place inside a gasoline engine.

Twenty members attended a technical meeting on December 22, at which Chairman William Bruning presided. Part II of the N.A.C.A. film *Drag* was shown. The December 29 meeting was omitted because of final examinations. A program is being planned to interest "lower junior" aeronautical engineering students in the Institute.

O.D.T. Expresses Appreciation for Meeting Cancellation

In a recent letter from the Office of Defense Transportation, Richard H. Clare, Special Assistant to the Director and Secretary of the War Committee on Conventions, expressed official appreciation for the Institute's cancellation of its Honors Night Dinner and the Technical Sessions of the Thirteenth Annual Meeting.

Mr. Clare wrote: "Colonel Johnson has asked that I express this Committee's appreciation of the Council's fine and patriotic action in canceling your annual sessions.

"This is, indeed, wholehearted cooperation in our efforts here on the home front."

An airplane's flight depends upon the unfailing teamwork of thousands of parts.

Consider an American Bosch Aviation magneto which produces the vital life spark of an engine. Take just one of its precision parts — the all-important coil. It contains nearly 1¾ miles of thread-thin copper wire.

Almost literally, the airplane hangs by that "thread."

Important as that wire is, it is only one of the precision parts which gives the American Bosch magneto its unfailing performance and dependability.

The magneto is just another product of American Bosch precision production for power — the result of engineering leadership and craftsmanship in the New England tradition.

This know-how is what attracts so many American engine builders to Springfield for solution of their ignition, fuel injection and related problems.

AMERICAN BOSCH CORPORATION • *Springfield 7, Massachusetts*

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PRECISION PRODUCTION FOR POWER

University of Notre Dame

On December 14 the Notre Dame Branch held its first meeting of the semester. It was attended by 25 students. The regular business of the meeting was first on the program. Seaman Cliff Marks, V-12 senior, was elected to fill the vacancy in the vice-chairmanship.

Plans discussed at the first meeting included a discussion of the new issue of the *Burble*, mimeographed publication of the Department of Aeronautical Engineering; an open meeting with the other engineering societies, sponsored by the I.A.S. Branch, at which it was planned to have H. E. Linsley, of the Wright Aeronautical Corporation, speak and show films; and a possible "Night Party" to include motion pictures, a speaker, and refreshments. After the business session had been completed, two films were shown: one about the P-38 and another called *Building a Bomber*.

A third meeting of the semester was held on January 11, with 33 members in attendance. There was a discussion of plans for a dinner and obtaining a speaker for a later meeting. After the business meeting the film *Fortress of the Sky* sent by the Institute, was shown, followed by *Cyclone Combustion*, sent by Wright Aeronautical Corporation.

University of Oklahoma

A meeting on December 18 was attended by 14 members; Chairman G. W. Hughes presided. The preparation of articles by student members on light aircraft, their engines and accessories, and helicopters and instruments was discussed, as well as possible articles on stress analysis for conferences to be held in April and May.

Instead of the motion picture originally scheduled, Vice-Chairman J. E. Popkess spoke for about 30 min. on "The Programming of Aircraft Distribution, Parts and Services." It was announced that L. A. Comp, of the Douglas Aircraft Company, Inc., would speak at a subsequent meeting.

Spartan College of Aeronautical Engineering

The Spartan College Branch held a combined technical and business meeting on December 4 at which George Petrus presided. Honorary Chairman Mann and George Petrus spoke briefly on the general subject of the aeronautical industry.

Three motion-picture films were shown, *Theory of Flight*, *Spark Plugs*, and *Magnesium from Salt Water*.

University of Texas

A group of 20 members attended a technical meeting on December 7. Chairman Merle Mueller presided. The films *Design for Flying* and *We Give Them Wings*, provided by Douglas Aircraft Company, Inc., were shown.

A combined business and technical meeting was held on December 21 under the Chairmanship of Merle Mueller. Dr. M. J. Barton, Professor of Aeronautical Engineering at the University, gave a talk about the organization of the Engineering Department at Douglas Aircraft Company, Inc.

News of Members

In the December issue the AERONAUTICAL ENGINEERING REVIEW carried a notice to the effect that **Peter Altman** became associated with Aeronca Aircraft Corporation as a Consulting Engineer. He continues to maintain consulting offices in Detroit.

Howard H. Ash has joined Edo Aircraft Corporation as Assistant Project Engineer.

Jay P. AuWerter has received his commission as a Captain in the U.S. Army Air Forces.

Robert W. Ayer is now Chief Operational Engineer with American Airlines, Inc.

Adriaan A. Boon Hartsinck has become an Associate in the firm of Alvin P. Adams & Associates.

Robert E. Britton has been appointed Flight Test Project Engineer at Boeing Aircraft Company.

Vernon O. Clapp has been commissioned a Commander in the U.S. Navy.

Nelson S. Davies has become Supervisor of Weight and Balance Control at Western Air Lines, Inc.

Andrew J. Fischer has been commissioned a Lieutenant in the U.S. Navy.

James E. Fitzpatrick has been appointed an Aeronautical Engineer at the Langley Memorial Aeronautical Laboratory of the National Advisory Committee for Aeronautics.

Ralph Friedman has become affiliated with the Fort Worth Division of Consolidated Vultee Aircraft Corporation as Layout Man.

Ray D. Gardner Jr., is now a Design Engineer with Northrop Aircraft, Inc.

Milton Gershon has transferred to Republic Aviation Corporation as a Layout Man.

Joseph T. Geuting, Jr., has been appointed Acting Manager of the Personal Aircraft Council of the Aeronautical Chamber of Commerce of America, Inc.

Walter M. Hartung, formerly Chief Instructor at the Casey Jones School of Aeronautics, has recently been commissioned a Major in the U.S. Army Air Forces.

Ralph N. Hartwick has been made Superintendent of the Modification Division of Goodyear Aircraft Corporation.

Robert R. Higginbotham, who is Chief Power Plant Engineer at Republic Aviation Corporation, has received a permanent appointment as Chairman of the Power-Plant Installation Sub-Committee of the National Aircraft Standards Committee.

Zay Jeffries, Technical Director of the Lamp Department at General Electric Company has been elected a Vice-President in charge of the newly created Chemical Department at General Electric Company.

Samuel P. Johnston, formerly Manager of Curtiss-Wright Corporation's Washington Office, has received the commission of Lieutenant Commander in the U.S. Naval Reserve.

Lyman C. Josephs, III, has been commissioned a Lieutenant in the U.S. Naval Reserve.

Robert F. Kahn has become affiliated with Edo Aircraft Corporation as Stress Analyst.

Ernest G. Keller has transferred to Curtiss-Wright Corporation as Consulting Engineer.

Ralph W. Kenyon has organized Kenyon Enterprises, of which he is President.

Charles M. Kicherer has joined the U.S. Marine Corps as a Lieutenant.

Ralph A. Kindler is now Senior Aircraft Engineer at Bechtel-McCone-Parsons Corporation.

Eugene J. Korda has been appointed Faculty Member of the Industrial Design Department of Pratt Institute, Brooklyn.

Merle A. Landis has been advanced to Senior Aerodynamicist for North American Aviation, Inc.

Wolfgang Langewiesche has joined the Kollsman Instrument Division of the Square D Company as Engineering Test Pilot.

Burnham Litchfield is now a Lieutenant in the U.S. Marine Corps.

Alexander J. McCulloch has become Junior Research Engineer in the Division of Mechanical Engineering of the National Research Council.

Thomas J. Martin has been promoted to the rank of Captain in the U.S. Army Air Forces.

Walter E. Mason was recently commissioned a First Lieutenant in the U.S. Army Air Forces.

Albert E. Mitchell has been appointed Assistant to the Chief Engineer at Luscombe Airplane Corporation.

Conrad N. Nelson has been promoted to the rank of First Lieutenant, U.S. Army Air Forces.

John S. Parker, Jr., is now a Captain in the U.S. Army Air Forces.

William C. Peck, formerly an Aeronautical Engineer with the Civil Aeronautics Administration, has become a member of the U.S. Army Air Forces.

Charles W. Penry has become a Lieutenant in the U.S. Army Air Forces.

Hillis S. Peterson has transferred to Ludington-Griswold, Inc., as Acting Chief Engineer.

Michael J. Phillips has joined the U.S. Naval Reserve as a Lieutenant.

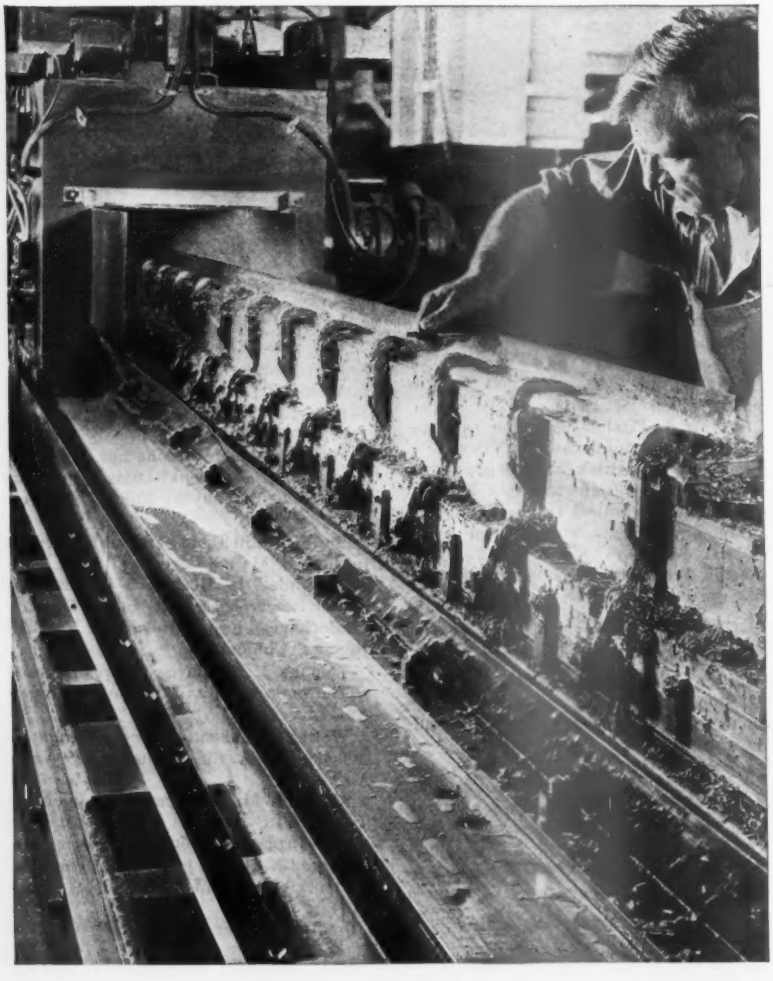
Perry E. Piatt has become affiliated with the Palmer-Bee Company at their Winston-Salem, N.C., branch as Chief Draftsman.

PRODUCING WING SPARS ON SHORT ORDER

By WILLIAM WINTER

Editor of "Air Trails" and author of "War Planes of All Nations" tells how Bell Aircraft has developed a spar milling machine that in twenty-two minutes does the job that once required twenty-four hours.

"THE Bell-designed spar milling machine is one of the great contributions this progressive company has made to speed up American aircraft production. Previous to the development of this mill, now being used by Bell and many other aircraft companies, it required twenty-four hours to complete a wing spar. Now these ingenious machines, covered by Bell Aircraft patents, turn out the spars for the giant Boeing B-29 Superfortresses being built in the Marietta Bell Aircraft plant in twenty-two minutes.



"The Bell spar milling machine, first developed in 1940, makes a cut two inches deep and four inches wide at the rate of sixty-five inches per minute.

"Under the old, slow method the material was fed into stationary cutter heads. In the Bell-designed mill the cutter moves across the metal, which is securely held to a bed by clamps that automatically drop down to let the cutting machinery pass and then jump up to grip firmly the spar behind the moving section.

"Since the cutting head runs on a cam which acts as a die, the machine cuts any contour up to twenty degrees.

"Each machine is its own meticulous housekeeper, for streams of coolant pumped onto the high speed cutter heads sweep away the shavings and deposit them into a central salvage pit.

"The advanced design which Bell engineers have built into this spar milling machine are further evidence that American 'know how' is the prime factor that now makes this country the greatest air power in the world.

"And when V-day dawns, this same engineering ability will be utilized in producing peacetime products that will bring this nation better living and greater values."

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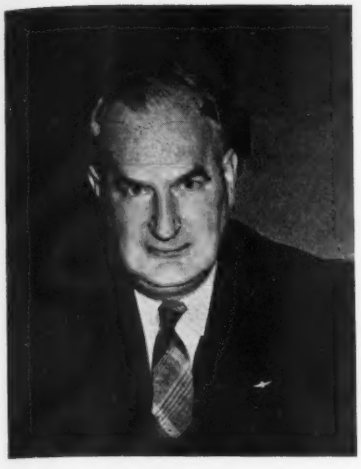

Roy C. Sylvander.

Esau Shimizu has recently joined the Marblehead Lime Company as Maintenance Engineer.

Morril B. Spaulding, Jr., is now with the Navy Department as Senior Aeronautical Engineer in the Bureau of Aeronautics.

Jerome Steffens has become a member of the staff of Platt-LePage Aircraft Company as an Aeronautical Engineer and Stress Analyst.

Roy C. Sylvander has been advanced to the position of Director of Engineering at the Eclipse-Pioneer Division of Bendix Aviation Corporation.

Avro A. Thurman has become connected with Lear Incorporated as a Design Engineer.

Francis D. Townsend has transferred to J. H. Williams & Company as Field Engineer.

Vincent C. Trimarchi has been made an Instructor in the Aeronautical Department at Rensselaer Polytechnic Institute.

Theodore F. Tulpan has been commissioned a Lieutenant in the U.S. Army Air Forces.

George H. Tweney has become Partner and Co-owner of Williams & Tweney.

John C. Vaffis has joined Fleetwings, Division of Kaiser Cargo, Inc., as Flight Test Engineer.

James E. Webb has received his commission as a Major in the U.S. Marine Corps.

Albert I. Wiebe is now Chief Technologist in charge of design gages and templates with Army Service Forces at the Office of the Quartermaster General in New York.

Donald P. Wilson is now a Lieutenant in the Navy Department, Bureau of Aeronautics.

Chester H. Wolowicz has been appointed as an Associate Aeronautical Engineer at the Langley Memorial Aeronautical Laboratory of the National Advisory Committee for Aeronautics.

The following members of the Institute have been commissioned Ensigns in the U.S. Navy and the U.S. Naval Reserve: **Frederick L. Brandau, Joel E. Brown, John E. Burkham, Albert J. Cullen, Leonard B. Edelman, Francis R. Gabarine, John P. Gratiot, Harold O. Hollenberg, Glen D. Hollinshead, Daniel Howland, Richard S. Huntzinger, Thomas F. Kieckhefer, Edwin H. Krug, Seymour Lampert, Paul A. Libby, Theodore F. Marble, Irving Michelson, John A. Nial, Lawrence M. Patrick, Felix A. Perry, Kenneth P. Pettibone, Wayland A. Pitman, Eugene F. Schmidt, Samuel E. Slaymaker, III, Ronald H. Smith, Donald L. Stull, Warren H. Underwood, Salvatore X. Xifo.**

Members Elected

The following applicants for membership or applicants for change of previous grade have been admitted to membership in the grades indicated since the publication of the list in the last issue of the REVIEW.

Elected to MEMBER Grade

Armstrong, Edward Thomas, B. in M.E.; Research Engineer, Battelle Memorial Institute.

Baker, Walter Ransom Gail, Dr., M.E.E.; Vice-President, General Electric Co.

Bernbaum, Lawrence, B.S. in M.E.; Research Asst., Massachusetts Institute of Technology.

Coffman, Robert Edward, M.S.; Captain, Transport Command, R.A.F.

Duke, William Meng, M.S. in Ae.E.; Asst. Dept. Head, Curtiss-Wright Corp.

Durocher, Ulysses Stayner, Liaison Engineer, The de Havilland Aircraft of Canada, Ltd.

Ellison, Arnold, Design Engineer-Group Leader, Aviation Div., York Research Corp.

Fiscus, Matthew Edwin, B.S. in Ae.E.; Engineer, Ford Motor Co.

Ford, Edwin W., B.S. in E.E.; Engineer, Goodyear Aircraft Corp.

Gardner, Tracy Bickford, Jr., B.A. in Ae.E.; Project Engineer, Northwest Airlines, Inc.

Halitsky, James, B.M.E.; Asst. Chief of Stress Analysis, Edo Aircraft Corp.

Hirschfield, Irving Deerfield, M.A. in Ae.E.; Major, Asst. Chief & Project Engineer, U.S. Army Air Forces.

Hoover, John Wesley, B.S. in Ae.E.; Asst. Project Engineer, Taylorcraft Aviation Corp.

Huntington, Dwight Williams, Chief Engineer, Skylark Mfg. Co., Inc.

Johnson, Nathan C., M.M.E.; Owner, Private Laboratory.

La Mar, Mrs. Frances Smith, A.B. in Eng.; Designer, Douglas Aircraft Co., Inc.

Micotti, Alfred Dominguez, M.S. in C.E.; Head of Airplane Specifications Section, Engineering Div., Bureau of Aeronautics, Navy Dept.

O'Brien, Edward Ransom, B.S. in Ae.E.; Group Engineer, Boeing Aircraft Co.

O'Hara, John James Andrew, Technical Officer, Ministry of Aircraft Production (England).

O'Sullivan, Richard Whitelegee, B.A.; Chief Aeronautical Engineer, Dept. of Defence, Irish Government (Ireland).

Oltmann, Adolph, Project Engineer, Edo Aircraft Corp.

Pratt, Perry Walter, B.S. in M.E.; Project Engineer, Pratt & Whitney Aircraft Div., United Aircraft Corp.

Robinson, George Elliott, S.M. in C.E.; Asst. Section Head, Curtiss-Wright Corp.

Russell, Dale Fiske, Asst. Project Engineer, Edo Aircraft Corp.

Simmonds, Oliver Edwin, Sir, M.A.; Managing Director, Simmonds Aerocessories, Ltd. (England).

Strong, Clinton Searle, Asst. Project Engineer, Sikorsky Aircraft Div., United Aircraft Corp.

Suppiger, Edward W., Ph.D. in Eng. Mech., Major, U.S. Army Air Forces.

Thompson, Albert Stanley, B.S. in M.E.; Development Engineer, Westinghouse Electric & Mfg. Co.

Thompson, Gale Eugene, B.S. in Ae.E.; Instructor, The University of Texas.

Tydon, Walter, Asst. Chief Engineer, Curtiss-Wright Corp.

Van Law, Jesse Mead, M.E.; Special Asst. to Manager, Pan American Airways System.

Walker, Edwin Witherby, B.S. in Ae.E.; Manager, Production Engineering, Link Aviation Devices, Inc.

Williams, David Carnahan, M.S. in C.E.; Stress Analyst, Curtiss-Wright Corp.

Transferred to MEMBER Grade

Butcher, James Andrew, B.S. in Ae.E.; Chief Aircraft Engineer, Northwest Airlines, Inc.

O'Meara, Paul Weber, B.S. in Ae.E.; Research Engineer, Langley Mem. Aero. Lab., N.A.C.A.

Souter, Robert Kimble, B.Ae.E.; Meteorologist, Langley Mem. Aero. Lab., N.A.C.A.

Thompson, Oscar Neil, B.S. in M.E.; Stress Analyst, Consolidated Vultee Aircraft Corp.

Elected to Industrial Member Grade

Emanuel, Victor, Chairman of the Board, The Aviation Corp.

Leiding, Oscar, B.A.; Associate Editor, *Air Transport,* McGraw-Hill Publishing Co.

Lippitt, George R., in charge Educational Development Dept., Ryan Aeronautical Institute.

Marshall, Alfred, Vice-President, Lawrance Aeronautical Corp.

Marvin, Walter Barber, Dept. Supt., Inspection, Eastern Aircraft Div., General Motors Corp.

Misner, James Barrison, Field Service Administrator, Consolidated Vultee Aircraft Corp.

Vaillancourt, Jeremie Alexandre, Engineering Representative (Eastern Area), Douglas Aircraft Co., Inc.

Voorhees, Sherman P., Major, U.S. Army Air Forces.

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Wilde, Stafford Harold, Operations Manager, Fleetwings Div., Kaiser Cargo, Inc.

Elected to Technical Member Grade

Abbott, Jack Gill, Jr. Structural Design Engineer, Goodyear Aircraft Corp.

Anderson, William Russell, Tool Engineer, Consolidated Vultee Aircraft Corp.

Boley, Lucius R., B.S. in C.E.; Stress Analyst, Eastern Aircraft Div., General Motors Corp.

Bulk, George Kenneth, B.S. in M.E.; Designer, Douglas Aircraft Co., Inc.

Cerasani, Americo James, Engineer, Curtiss-Wright Corp.

Conner, David William, B.S. in M.E.; Asst. Mech. Engineer, Langley Mem. Aero. Lab., N.A.C.A.

Drapkin, Bernard, B.A. in M.E.; Research Engineer, Atlas Aircraft Products Co.

Duppstadt, Jay Robert, B.S. in M.E.; Stress Analyst, Curtiss-Wright Corp.

Enochian, Samuel Harry, B.S.; Review Quality Representative, Curtiss-Wright Corp.

Evans, William Ellsworth, B.S.; Sr. Stress Analyst, Goodyear Aircraft Corp.

Fanucci, Jerome Ben, B.S. in Ae.E.; Jr. Stress Engineer, Eastern Aircraft Div., General Motors Corp.

Forster, Fred Charles Moffitt, Liaison Engineer, Victory Aircraft Ltd. (Canada).

Hodgson, Robert, Jr., M.S.

Holtzer, Irwin, B.S. in Ae.E.; Operations Planning Engineer, American Export Airlines, Inc.

Janis, Charles Laurren, Stress Analyst, The de Havilland Aircraft of Canada, Ltd.

Johnson, George Glen, Chief Loftsman, Rohr Aircraft Corp.

Larson, Donald Charles, B.S. in Ae.E.; Stress Engineer, Hudson Motor Co.

Newland, Kenneth Edward, M.A.; Head of the Aviation Dept., Stephens College.

Norvell, Robert Dean, B.S. in M.E.; Engineering Draftsman, Douglas Aircraft Co., Inc.

O'Brien, Jack James, A.B.; Stress Analyst, The Ryan Aeronautical Co.

Rothchild, Oscar Abraham, B.S. in Ae.E.; Practicing Engineer, Cribben & Sexton Co.

Stulen, Frank Lem, B.S.; Capt., U.S. Army Air Forces.

Warfield, Harry Robinson, Pvt., U.S. Army Field Artillery.

Weld Peter Edgar, Test Pilot, Packard Motor Car Co.

White, Norman Arthur, Technical Asst., D. Napier & Son Ltd.

Transferred from Student to Technical Member

Anthony, William Arthur, B.S. in M.E.; Service Engineer, Sperry Gyroscope Co., Inc.

Arenz, Robert James, B.S. in M.E.

Bumsted, Bartram Washburn, B.S. in E.; Midshipman, U.S.N.R.

Carmichael, Bruce Houghton, B.S. in Ae.E.; Aero. Engineer, Chance Vought Aircraft Div., United Aircraft Corp.

Colby, Starr Jocelyn, B.Ae.E.; Jr. Aerodynamicist, The Glenn L. Martin Co.

Cummings, Robert Forest, B.S. in Ae.E.; Aero. Engineer, Langley Mem. Aero. Lab., N.A.C.A.

Cunningham, John Hugh, B.Ae.E.; Seaman 1/C, U.S. Navy.

Flaherty, Edmund Joseph, B.S. in Ae.E.; Pvt., U.S. Army Air Forces.

Grimes, James Henry, Jr., Asst. in Wind Tunnel (Wright Bros.), Massachusetts Institute of Technology.

Hamilton, Byron Keith, B.Ae.E.; Aero. Engineer, Ames Aero. Lab., N.A.C.A.

Herrick, Robert Nicolls, B.S.; Pvt., U.S. Army Air Forces.

Johnson, Walter Henry, B.Ae.E.; U.S. Army Air Forces.

Kase, Paul George, Jr., B.S. in Ae.E.; Flight Research Engineer, Curtiss-Wright Corp.

Krinsky, Robert Stanley, B.Ae.E.; Aerodynamicist, Sikorsky Aircraft Div., United Aircraft Corp.

Lipes, Russell Magee, Jr., B.S. in Ae.E.; Test Engineer, Pratt & Whitney Aircraft Div., United Aircraft Corp.

Loupe, William Marcellus, B.Ae.E.; Engineer, Taylorcraft Aviation Corp.

Miller, Robert Rick, B.Ae.E.; Research Lab. Analyst, Lockheed Aircraft Corp.

Petrus, George Anthony.

Phillips, Warren Leslie, B.Ae.E.; Midshipman, U.S.N.R.

Potter, John Leith, B.Ae.E.; Jr. Staff Engineer, Curtiss-Wright Corp.

Rappaport, Irving, B.S. in Ae.E.; Pvt., U.S. Army Air Forces.

Schaffzin, Stanley Daniel, B.S. in Ae.E.; Pvt., U.S. Army Air Forces.

Schock, Waldo Harrison, Jr., B.S. in Ae.E.; Instructor, Head of Dept. of Aero. Engineering, Indiana Technical College.

Schwartz, Milton Mayer, B.S.; Aerodynamicist, Chance Vought Aircraft Div., United Aircraft Corp.

Slivinsky, Cornell Joseph.

Terry, LeGrand Emerson, B.Ae.E.; Apprentice Engineer, American Export Airlines, Inc.

Tompkins, James Haviland, Jr., B.S.E.; Midshipman, U.S.N.R.

Voutsas, Alexandros M., B.Ae.E.; Radio Technician Student, U.S. Navy.

Workman, Leland Junior, B.Ae.E.; Jr. Engineer, Boeing Aircraft Co.

Elected to Affiliate Grade

Lane, Bruce Rexford, Process Checker-Tool Designer, Ranger Aircraft Engines Div., Fairchild Engine & Airplane Corp.

Leland, Frank Gardner, Production Control Dispatcher, Sacramento Air Service Command.

Stonehouse, Charles Ross, Inspector (Aeronautical), R.C.A.A.

Stong, Galen Q., Aviation Cadet, U.S. Army Air Forces.

Wills, Ernest William Leonard, Technical Lecturer, Air Ministry (England).

Correction

Through a mechanical error, the following names were listed in the January issue under "Transferred to MEMBER Grade" instead of "Elected to Technical Member Grade."

Binegar, Lewis Albert, B.S. in General Engineering; Service Engineer, Curtiss-Wright Corp.

Brace, Floyd Robert, B.S. in M.E.; Engineer, Boeing Aircraft Co.

Burkhardt, Frank, Structural Design Engineer (Arizona Div.), Goodyear Aircraft Corp.

Crenshaw, Charles Sterling, LL.B.; Research Asst., Wayne University.

Crowell, William Eleazor, B.S. in M.E.; Head, Altitude Chamber Section, Airplane Div., Curtiss-Wright Corp.

Emmerson, John Outram, B.A.Sc.; Jr. Engineer, The de Havilland Aircraft of Canada, Ltd.

Hunter, Paul Albert, B.S. in M.E.; Langley Mem. Aero. Lab., N.A.C.A.

Kisselberg, Ervin Thomas, B.S. in M.E.; Structural Test Engineer, Boeing Aircraft Co.

Kittrell, Oliver Terry, Jr., Lt., U.S. Army Air Forces.

Lane, Jack Junior, Supervisor of Technical Information, Cleveland Aircraft Div., General Motors Corp.

Lesk, Norman, Asst. Group Leader, Engineering Dept., Fleetwings Div., Kaiser Cargo, Inc.

MacArthur, Arthur, Jr., Draftsman, P-V Engineering Forum, Inc.

Necrology

Frederick Walker Castle

Frederick Walker Castle, a Technical Member of the Institute and a Brigadier General in the U.S.Army Air Forces, was killed in action on December 24 when the B-17 Flying Fortress piloted by him was shot down by seven Messerschmitts in the vicinity of Liége, Belgium, while he was leading an attack. He was the commanding officer of a bomber wing of the Third Air Division.

General Castle was 36 years of age and a native of Manila, Philippine Islands, where he was born October 14, 1908. His precollege education was obtained at Maris Brothers College, Tientsin, China, and at other schools in Paris and the United States. He was graduated from West Point in 1930 and was assigned to the Air Corps for flight training. This was followed by service with the Seventeenth Pursuit Squadron at Selfridge Field and elsewhere.

At the time of General Castle's return to active service in the Army Air Forces he was Assistant to the President of Sperry Gyroscope Company, Inc. In January, 1942, he assisted Lt. Gen. Ira C. Eaker and other officers in establishing the Eighth Air Force bases in England. At his own request he was transferred from administrative work to combat flying and was engaged in his thirtieth mission at the time of his death. He had received the Silver Star for gallantry in action, the Legion of Merit, the Distinguished Flying Cross with two oak-leaf clusters, and the Air Medal with three clusters, as well as decorations from France and Russia for services to those countries.

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LONELIEST RADIO STATIONS

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This is United Air Lines' radio communications station, remotely-controlled from a hangar at La Guardia Field. The pilot's contact with the ground, it transmits such vital information as weather conditions, wind direction, and air traffic instructions.

Here dependability is a *must* . . . and this Federal transmitter – the FTR-5 – is on the job every minute of the day, every day of the year. The only direct human attention it receives is a routine inspection visit . . . about once a month.

The need was for efficient, unfailing service . . .

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Personnel Opportunities

This column is for the use of individual members of the Institute seeking new connections and organizations offering employment to aeronautical specialists. Any member or organization may have requirements listed without charge by writing to the Secretary of the Institute.

WANTED

Aeronautical Engineers, Stress Analysts, Layout and Detail Draftsman—Excellent opportunities in the Engineering Division to carry out original design work on all phases of helicopter development program. Applicants must comply with W.M.C. regulations. Write stating education, experience, age, draft status to Administrative Engineer, Kellett Aircraft Corporation, Plant #2, Upper Darby, Pa.

Instructor or Professor to teach Airplane Design, Airplane Structures, and related subjects. Master's degree preferred, experience in industry required. Rank and salary depend upon training and experience. Address inquiries to Prof. D. W. Dutton, Director, Daniel Guggenheim School of Aeronautics, Georgia School of Technology, Atlanta, Ga.

Engineering Pilot, with Army, Navy or Marine flight training is desired. Engineering education, preferably an aeronautical degree, pilot license to fly both single- and multi-engined airplanes is required. Pilot must pass military aero-medical physical examination as some work may involve flights at high altitudes. Address inquiries to the Chief Engineer, Curtiss-Wright Corporation, Propeller Division, Caldwell, N.J.

Aircraft Engineers—Positions available in Clifton & Caldwell, N.J., for Tool & Gage Engineers. Also engineers for manufacturing process, production methods, also design engineers, Seniors & Juniors. Manufacturing operation sheet writers, designers, tool & gage; gage analysts, tool & gage draftsmen. Applicants must have Aeronautical Industrial Manufacturing experience. Must have certificate of availability. Call in person or write Employment Office, Curtiss-Wright Corp., Propeller Division, 143 Getty Ave., Clifton, N.J.

Detail and Layout Draftsmen, Stress Analysts, and Design Engineers needed for development work in the Engineering Department. Must be citizen, not employed in essential war industry, or have a certificate of availability from the U.S. Employment Service Office or the War Manpower Commission of your area. Address inquiries to Curtiss-Wright Corporation, Airplane Division, Buffalo, N.Y.; Attention: Director of Engineering.

Aeronautical Engineer—Six years' experience, rotor wing aircraft experience desirable, power-plant installation or some design and structural layout experience necessary. Address inquiries to Mr. Enea Bossi, Higgins Industries Incorporated, New Orleans 19, La.

Detail & Layout Draftsmen, Stress Analysts, Design Engineer, Assistant Project Engineer on development work in the engineering department. Address inquiries to Edo Aircraft Corporation, 136-48 Roosevelt Avenue, Flushing, L.I., N.Y.

Aeronautical Engineer—graduate or equivalent in experience. Good working knowledge of airplane design, structure, materials, and stress analysis desirable. Background of naval aircraft specifications and manufacture considered excellent. Pleasing personality is essential. Apply or write to the Bureau of Aeronautics Representative, c/o Edo Aircraft Corporation, 13–10 111 Street, College Point, N. Y.

Aerodynamics Engineer—Practical experience wanted by well-known long-established mid-west manufacturer to conduct technical research and market development in ventilating and air-cooling division. Attractive salary for man of ability and ambition. Address inquiries to Box 275, Institute of the Aeronautical Sciences.

Mechanical, Chemical or Metallurgical Engineer, experienced in fabricating and bonding aluminum alloys, to function as project engineer in conversion of copper exchange heat devices to all aluminum construction for aircraft applications. Mid-west location, position permanent. Salary commensurate with experience and ability. Address inquiries to Box 271, Institute of the Aeronautical Sciences.

Contact Man—to aircraft industry, travel mid-west and east representing manufacturer of heat transfer equipment. Engineering and previous contact with aircraft industry desirable but not essential. State background and previous employers and enclose photo. Address inquiries to Box 266, Institute of the Aeronautical Sciences.

Aero & Mechanical Engineers—Large engineering firm engaged in military work with growing backlog of postwar jobs needs engineering personnel in all categories: Designers, Layout & Detail Draftsmen, Stress Analysts, Checkers, etc. Location Manhattan. W.M.C. rules observed. Address inquiries to Box 263, Institute of the Aeronautical Sciences.

Chief Design Engineer—Graduate mechanical engineer, experienced on automotive radiators, with established AAA-1 high production manufacturer of automotive radiators. Worth-while salary. Sound peacetime future with resumption of automobile production. Write in complete detail. Enclose recent (nonreturnable) photo. Address inquiries to Box 252, Institute of the Aeronautical Sciences.

Industrial Engineers—Major coast to coast air line, strong background on accounting systems, operating cost accounting and capital items depreciation; must be willing to leave city. Permanent position offering unlimited opportunity. Describe background in detail. Enclose photo. Address inquiries to Box 240, Institute of the Aeronautical Sciences.

AVAILABLE

Graduate Aeronautical Engineer—Seven years' experience, 2 years in naval aircraft factory. Especially interested in jet propulsion and rotating wing aircraft, several months' experience in latter. Desires responsible position with postwar future. Address inquiries to Box 281, Institute of the Aeronautical Sciences.

Registered Professional Aeronautical Engineer, with successful consulting practice, has time available for new client. Graduate degrees from two Universities, eight years' experience in airplane design, aerodynamics, and structural design. Location mid-west, but will travel to suit client. Retainer fee or contract basis. Address inquiries to Box 280, Institute of the Aeronautical Sciences.

Engineering Test Pilot—Ten years' flying experience, Army trained, three years of experimental test flying with prominent manufacturer of multi- and single-engined military airplanes. B.S.-M.E. degree, majored in Aeronautical Engineering. Proven executive ability. Desires to change company affiliation. West Coast preferred. Address inquiries to Box 279, Institute of the Aeronautical Sciences.

Aeronautical Engineer—Over 15 years of practical and well-rounded experience with wide organizational background as executive engineer (equivalent to assistant chief engineer), chief project engineer, project engineer, design and acting chief draftsman in charge of scheduling, personnel and drafting room practice on military and commercial aircraft. Hard working. Desires responsible position with postwar future. Detroit area preferred, but other locations will be considered. Now employed, available 3–4 weeks. Release available. Address inquiries to Box 278, Institute of the Aeronautical Sciences.

Aeronautical Engineer—B.S.M.E. A.E., three years' experience with Technical Development Division, C.A.A., and two years' experience in aerodynamics of helicopters with Aircraft Engineering Division, C.A.A., desires responsible position with postwar future in aircraft company located in or near New York City. Address inquiries to Box 277, Institute of the Aeronautical Sciences.

New rubber joint seals ai

B. F. Goodrich FLEXLOCK COUPLING

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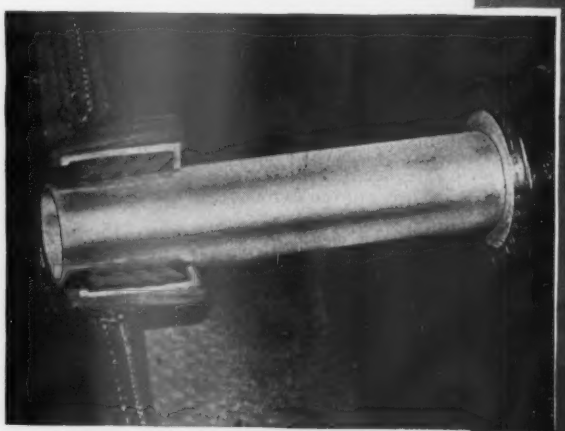
PROVED FOR YEARS on industrial piping applications, B. F. Goodrich Flexlock couplings are now being adapted to many aircraft uses. They are effective as seals or flexible joints, and are ideal for uses where vibration is a problem.

The Flexlock coupling is a molded rubber gasket specially ribbed inside and out. Coupling is placed in the larger diameter pipe and the smaller pipe forced inside the coupling. Compression causes the ribs to grip both pipes securely. The result of the gripping and sealing action of the inner and outer sets of ribs is a tight joint.

Flexlock couplings have five outstanding advantages: (1) *Quick application*—takes only few seconds; (2) *Low cost*—time saved and low cost of seal itself make Flexlock cheapest method in many cases; (3) *Adaptable*—adapts itself to rough surfaces; (4) *Leak-proof*—constant pressure is exerted on all surfaces touched by seal; (5) *Positive flexible coupling*—vibration won't loosen Flexlock.

B. F. Goodrich Flexlock couplings can be made of natural or synthetic rubber, depending on use. Rubber can be compounded with resistance to aromatics, hot and cold gases, and liquids such as commercial acids, alcohol, water, gasoline and oil.

Flexlock couplings are available now for experimental uses, some of which are described below. Our engineers will be glad to work on applications with you. Write to The B. F. Goodrich Co., Dept. F-2, Aeronautical Division, Akron, O.



• SUGGESTED USE of Flexlock in fuel system to show how it might be applied. Cutaway section shows how ribs grip both pipes securely. Other possible applications—high pressure grommet seals for passing conduits through pressure chamber bulkheads, etc.; flexible joints in bell and spigot tubing carrying gases and liquids.

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LANDING WHEEL TIRES • TAIL WHEEL TIRES
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ls airplane plumbing lines

• FAST INSTALLATION is big Flexlock feature. All you do is push coupling inside larger diameter pipe.

• . . . then just push smaller diameter pipe inside the larger one to complete joint.

• Joint takes terrific direct pull but can be separated by twisting, unscrewing action.

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B.F. Goodrich

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THINK of it! One-fourth shorter takeoff runs! One-third higher rate of climb! Cruising faster and farther at the most favorable altitude! All with minimum fuel consumption and engine wear. That's what Aeromatic—*the one and only self-acting variable pitch propeller*—means for that postwar plane of yours. And it means long glides for happy landings—with an instantaneous change of pitch for a quick pickup if you overshoot the field.

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If you fly, or plan to fly, you will want an Aeromatic Propeller on your plane. Write to your aircraft manufacturer about it today. And if you'd like our little get-acquainted folder, containing a diagram of the "brain" in an Aeromatic, drop us a line. We'll be glad to hear from you.

The Propeller with a Brain for Tomorrow's Plane

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Air Controlled *Automatic Propeller*

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Licensed under patents of EVEREL Propeller Corporation

Engineer—B.Ae.E., recent graduate, presently employed in material and process group of leading aircraft manufacturer, unmarried, draft deferred, willing to travel, can obtain release from present employer. Desires position primarily concerned with dealing with people but requiring a technical background. If such position is available please contact and résumé will be furnished immediately. Address inquiries to Box 276, Institute of the Aeronautical Sciences.

Engineer—Three years college, 27 years old, rotating wing experience. Desires change to larger plant. Work in research desired. Married and retired 1st Lieutenant from Air Corps. Also a licensed navigator with 800 hours of ocean flying. Address inquiries to Box 274, Institute of the Aeronautical Sciences.

Aeronautical Engineer—Responsible for the development of several successful aircraft, desires additional design or supervision work under contract. Address inquiries to Box 273, Institute of the Aeronautical Sciences.

Aeronautical Engineer—A graduate engineer with 14 years' continuous aircraft experience in research, development, and design of military and commercial airplanes desires connection offering immediate and postwar opportunities. Past experience included positions as Project Engineer, Chief Project Engineer, Assistant Chief Engineer, and Chief Engineer. Has demonstrated ability to organize and supervise engineering departments and to maintain direct responsibility for important experimental and production airplane design projects. Prefers position where technical knowledge and the attainment of close Engineering-Production cooperation is required. Address inquiries to Box 272, Institute of the Aeronautical Sciences.

Aeronautical Engineer and Pilot—B.S. and M.S.E., Commercial Pilot, three years' experience in flight-test work involving handling characteristics of a variety of airplanes. Can get full release for position that involves flying. Would prefer position where engineering and flying can both be used. Address inquiries to Box 270, Institute of the Aeronautical Sciences.

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Power Plant Development Engineer—Six years' experience in research, design, and development. Familiar with the aerodynamic, thermodynamic, and metallurgical aspects of gas turbine development. Address inquiries to Box 267, Institute of the Aeronautical Sciences.

Aircraft Factory Executive—Under 40; 17 years' aeronautical experience; broad background. Been Factory Manager, Research Chief, Quality Manager, and Chief Inspector for reputable U.S. aircraft manufacturers; also C.A.A. inspector. Experienced on rotating wing, amphibious, and conventional aircraft; Army, Navy, and Commercial standards; metal, wood, and plastic construction; modern managerial and production methods. Nine Federal Licenses. Proven research and inventive ability; some sales (about 50 airplanes), piloting (1,700 hours), radio (4 stations), and yachting experience. Want management position with progressive company (preferably making helicopters, amphibians, or private owner airplanes). Take up to 50 per cent of salary in company stock. Now in East. Statement of availability, and best of references. Address inquiries to Box 265, Institute of the Aeronautical Sciences.

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Industrial Engineer—Broad and varied experience in Plant Layout, Tool Design, Tool Control, Methods, Procedures, Hours Control, Work Simplification, Cost Analyzation, Incentives and Reports. Wants responsible position; can go anywhere; now employed; can comply with W.M.C. Regulations. Address inquiries to Box 256, Institute of the Aeronautical Sciences.

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Consultant Aeronautical Engineer—Honorably discharged Army Air Forces, formerly executive Chief Engineer, Administrator, Designer desires new connections or additional consultant work. Preliminary aircraft design and jet propulsion specialist. Address inquiries to Box 205, Institute of the Aeronautical Sciences.

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Periodicals

Accessories and Equipment

Efficiency of Panel-Type Systems in Airplane Cabin Heating. B. F. Raber and F. W. Hutchinson. Problems of the utilization of heat to make the cabins of airplanes comfortable during flights through cold outside air are examined. It is stated that, in terms of performance as sources of primary irradiation, low-temperature flat-plate panels are relatively inefficient, since an average of only about 2 per cent of the energy emitted by the heating surface is likely to be received by the occupant in the usual cabin installation. However, judged as a convecting surface with the additional characteristic of fractional irradiation, such panels possess operating advantages that dictate their use under certain conditions. The article gives briefly the heat-loss criteria which, in large measure, serve as indexes of the comfort of aircraft occupants. By means of an illustrative example, the discrepancy occurring through the consideration of the same cabin-heating problem in different ways is investigated. The writers show how to calculate allowable loss of body heat and the rate of direct transmission of radiant energy, and how to determine the proper temperature for comfort. They analyze the ineffectiveness of panels as sources of primary irradiation and the effectiveness of irradiation from panels as convectors. It is shown that a low-temperature flat-plate heating panel is basically a convective type of comfort-heating surface. However, it is pointed out that the small amount of direct irradiation realized from such a panel constitutes a significant energy "dividend" that makes the panel a more effective and more economical method of heating than are the usual types.

The general conclusion is that panel-type heating systems are practicable, establish optimum comfort, and operate with an energy consumption usually less than, and never more than, that of the best designed convective heating system. Heated flat-plate ceiling panels give excellent results wherever they are designed to function as a complete heating system. The only condition under which they do not perform well is when they are misused for the pattern of primary radiation exclusively. The designer is advised not to rely on the primary exchange equation but to analyze the installation comprehensively as a problem in equilibrium heat balances. *Aero Digest*, December 1, 1944, pages 83–85, 132, 2 illus.

British Make Drop Tanks for USAAF. Details are given about the auxiliary drop tanks that have been supplied by the British for use on American fighter aircraft. These 108-gal. tanks are reported to be made entirely of paper with wooden baffles. Six main parts comprise the paperboard sections of the cigar-shaped tank: the body tube, the head, the tail, two joining spigots, and a baffle spigot. These are made of laminated kraft paper, supported internally at the strapping points by plywood baffle plates mounted in short paper tubes that fit tightly against the inside surface of the shell. Approximately 100 in. in length and 21 in. in diameter, the tank is clamped to the plane by means of two steel straps 19 in. apart passing around the cylindric center section. *Western Flying*, December, 1944, page 98, 2 illus.

Ventilation of Modern Aircraft. Albert A. Arnhym. An analysis of the problems of ventilating aircraft cabins deals with conditions at altitudes at which the partial pressure of the oxygen is sufficient for the breathing needs of the human body and the air pressure is high enough to disregard the effects of low density. Quantity, quality, and distribution are the three main problems under those conditions. Although ventilation requirements should be considered independently from those of heating, the two are related because the amount of air required to distribute heat must be taken into consideration in designing the ventilation system. Quoting standards to establish minimum requirements for maintaining proper breathing, advice is offered for calculating the quantity of air to be supplied. The second factor in good ventilation is quality of the air introduced, involving the rate of circulation, humidity, and filtration, all of which are discussed. Distribution is the third factor, and it is treated in a discussion of duct systems, air scoops, blowers, and the avoidance of drafts, stratification, foul-air pockets, and short-circuiting between inlets and outlets. Basic ducting methods are outlined and the overhead system is recommended by the writer wherever it is feasible. The article closes with an outline of the different types of air inlets and with a forecast that the eventual solution of the problems will lead to systems of full air conditioning in the truest sense of the word. *Aero Digest*, December 15, 1944, pages 111–113, 232, 4 illus.

INDEX

Accessories and Equipment.... 61
Aerodynamics..... 63
Air Cargo..... 65
Air Power..... 65
Air Transport..... 65
Airplane Descriptions..... 68
Airports and Airfields..... 71
Armament..... 73
Business and Finance..... 75
Civil Aviation..... 75
Control Equipment..... 75
Deicing..... 75
Design..... 75
Electrical Equipment..... 79
Engines..... 83
Flight Technique..... 84
Fuels..... 84
Gliding and Soaring..... 87
History..... 87
Hydraulics..... 87
Inspection..... 87
Instruments..... 89
Maintenance..... 89
Management..... 91
Marketing..... 93
Materials..... 95
Medicine..... 95
Military Aviation..... 95
Paints and Coatings..... 97
Personalities..... 97
Personnel..... 97
Photography..... 97
Plastics and Plywood..... 97
Postwar Aviation..... 99
Private Flying..... 99
Production..... 99
Propellers..... 102
Radio..... 102
Reaction Propulsion..... 102
Reconversion..... 105
Rotating Wing Aircraft..... 105
Stress Analysis..... 105
Superchargers..... 109
Testing..... 111
Testing Equipment..... 111
Tools and Equipment..... 111
Training..... 113
Warfare..... 113
Weight Control..... 113
Welding..... 113

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Aerodynamics

The views and opinions expressed in this section are exclusively those of the writers or publications named. They are in no case to be construed as those of the Aeronautical Engineering Review or the Institute of the Aeronautical Sciences.

Wing Flaps in Light Aircraft Design. Maurice A. Garbell. The use of wing flaps on light airplanes is oftentimes considered to be a complication of questionable value because the attainment of high maximum lift coefficients results only in a nominal reduction of the stalling speed of such airplanes, which ordinarily have a low wing loading.

On aircraft with high wing loading and low power loading the following two factors are instrumental in diminishing the value of wing flaps:

(1) Wing flaps improve the airplane performance at high lift coefficients only, where the flight and control characteristics of such aircraft, primarily designed for high-speed operation, are usually not considered satisfactory.

(2) The power/drag-area ratio is so high in this category of airplanes that aerodynamic improvements, such as those offered by wing flaps, cannot affect the most important performance items except the stalling speed and the angle of glide to any appreciable amount.

On aircraft with low wing loading and comparatively high power loading, such as the average light airplane, these two factors are substantially modified because:

(1) Flight and control characteristics of light aircraft are designed for low-speed operation, and full advantage can be taken of any improvement of performance at low flying speeds offered by wing flaps.

(2) The power/drag-area ratio is low, and aerodynamic improvements on the wing may affect the performance characteristics of the airplane considerably.

The purpose of this paper is to show some of the quantitative gains and design problems that may be expected from the incorporation of wing flaps on a typical four-seater light airplane of the immediate postwar period. *Journal of the Aeronautical Sciences*, January, 1945, pages 14–20, 19 illus.

Investigation of the Wing-Wake Frequency with Application of the Strouhal Number. M. Zbigniew Krzywoblocki. This paper consists of two parts. The aim of the first part is to record the results of calculation of the Strouhal Number in two-dimensional flow behind an infinite plate, an infinite circular cylinder, and an infinite airfoil. The results obtained are compared with those from previous tests, and sometimes a fair agreement is obtained. The most important conclusions are as follows:

(1) In general the Strouhal Number is not a constant.

(2) The Strouhal Number in the wake behind a body with sharp edges is approximately constant.

(3) The Strouhal Number in the wake behind a circular cylinder is constant only below the critical Reynolds Number. Above the critical Reynolds Number some assumptions permit the conclusion that as a first approximation the Strouhal Number is a linear function of the Reynolds Number.

(4) When the wake behind an airfoil consists of vortex rows, the value of the Strouhal Number behind the airfoil, referred to the projection of the airfoil on the direction perpendicular to the direction of the flow, may be assumed as a constant.

In the second part of this paper the results of some tests in a wind tunnel in two- and three-dimensional flow are presented. The following bodies were tested: (a) airfoil in two-dimensional flow, (b) airfoil of finite length, (c) airfoil with flap in two-dimensional flow, and (d) airfoil with flap of finite length.

The purpose of the tests was to find and to compare the values of the Strouhal Number behind the above-mentioned bodies. The results of the tests proved that:

(a) When the value of the Strouhal number of any airfoil in two-dimensional flow, with or without flaps, is referred to the projection of the airfoil on the direction perpendicular to the direction of the airflow, the values of the Strouhal Number are within the limits of the values given by other investigators.

(b) The frequency in the wake behind the center span of a rectangular airfoil of finite length is not affected by the tip vortexes.

(c) The graph of frequency versus velocity appears to be a straight line, but it is difficult to see whether it always passes through the origin of coordinates, although a slight tendency is visible. Blenk obtained straight lines passing through the origin, but his results do not agree with results obtained by Abdrashitov. *Journal of the Aeronautical Sciences*, January, 1945, pages 51–62, 8 illus.

The Influence of Structural Deformation on Airplane Characteristics. Alexander H. Flax. The effects of elastic deformation of wings and tail on the air loads imposed upon them have been studied in the past by a number of investigators. These previous investigations have been mainly concerned with the occurrence of instability conditions, such as divergence or loss of control, imposed by conditions such as aileron reversal. Much of the previous work has been done on the basis of simplified equivalent two-dimensional wings or on the basis of the semirigid wing, commonly used in British reports on flutter and aero-elastic effects. Also, the effects of induced down-wash have usually been treated in a rough manner or neglected.

This paper includes the effects of induced down-wash and considers the wing as a three-dimensional structure. The analysis made treats not only the criteria for divergent instability and other critical conditions but also the aerodynamic characteristics, including spanwise lift distribution, for speeds below divergence.

The discussion is developed by consideration of a simplified problem involving a wing of infinite span, followed by the problem of twist and spanwise distribution for a wing of finite span and varying properties. The effects on the maneuverability of an airplane in roll resulting from the structural deformation accompanying the operation of the aileron are discussed with regard to the rolling moments of a flexible wing. A simplified formula is derived for aileron reversal speed, and mixed deformation and instability are analyzed, as well as wing and tail flexibility.

Other changes in airplane characteristics not treated in this paper may be treated by the methods outlined.

Aero-elastic effects are likely to be serious not only in high-speed airplanes but also in large, heavy airplanes. The design load factors on large airplanes are lower than on small airplanes, so that the structures required for strength become relatively lighter. Such airplanes are then subject to changes in aerodynamic characteristics attributable to flexibility. Since the present trends in design are toward higher speeds and larger airplanes, aero-elastic effects are likely to become increasingly important in the next few years. *Journal of the Aeronautical Sciences*, January, 1945, pages 94–102, 8 illus.

Airfoil Theory for Flows of Variable Velocity. Rufus Isaacs. In many cases of aircraft practice—notably that of the rotating wing—the lift surfaces are in air streams of variable velocity. There are two resulting effects that are excluded from a direct application of the usual airfoil formulas. One arises from the continuous wake of vortexes which are shed from the trailing edge with each change of circulation; the other, from the impulsive pressure because the air masses are accelerating. The purpose of this paper is to study this aerodynamic problem, taking into account these effects with a certain but sufficient degree of approximation.

The first section deals with the general problem of an airfoil at constant angle of attack but with a variable stream velocity. The main result is an integro-differential relation between the velocity and circulation which is true for general flows. It is given in two forms: the realistic, where the airfoil is assumed at some time to have started from rest; and the periodic, where the flow is periodic.

The second section is a complete solution to the important practical case: velocity = constant + sinusoidal variation.

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In the third section the lift is calculated. In particular, an explicit formula is given for the case of the second section in the form of a Fourier series. The moment is not evaluated since the technique is similar.

Finally, the solution to a numerical example is given. *Journal of the Aeronautical Sciences*, January, 1945, pages 113–117.

Calculated Gust Loads for Tailless Airplanes. Raymond F. Anderson. Gust-load factors are calculated for tailless airplanes by a simplified method that includes directly the effect of the pitching motion. The calculations are made for a wide range of mass parameter (a quantity that includes both wing loading and chord), center of gravity position, and pitching radius of gyration. A linear gust with the maximum gust velocity at the critical distance of eight chord lengths is used. Although certain assumptions are made in order to simplify the calculations, it is shown that for a typical case the results agree with the results obtained by a rigorous solution.

The application of the results to tailless airplane design is illustrated by typical curves showing the variation of the limit load factor with wing loading for various values of center of gravity position and radius of gyration. It is found that the load factor is reduced by a forward movement of the center of gravity or by a reduction of the radius of gyration. For example, a representative case shows that, for a range of mass parameter from 5 to 30 (a variation of wing loading from 10 to 60 lbs. per sq.ft. for a 12-ft. chord), a movement of the center of gravity of 5 per cent chord forward of the aerodynamic center causes reductions of the limit load factor of 26, 11, and 3 per cent, for values of the ratio of the radius of gyration to the chord of $^1/_4$, $^1/_2$, and 1, respectively. *Journal of the Aeronautical Sciences*, January, 1945, pages 118–122, 7 illus.

Air Cargo

Air Cargo and Customs. Joseph Gamburg. Some features of customs practice with which air-cargo carriers are most directly concerned are discussed. The article is intended to provide information for air shippers and to encourage constructive thinking with regard to present and future customs problems. In reference to possible changes in the customs process, it is stated that the subject should be studied now while there is enough but not too much cargo, at enough but not too many airports, to make ideal the conditions for such a study. Sections of the article deal with the responsibilities of the air lines, the principal features of the bond, the expense of customs services to the air lines, and procedure changes anticipated. *Air Transportation*, November, 1944, pages 7–10.

Realism Needed in Air Cargo Discussions. E. J. Foley. The writer urges that a more realistic view be taken regarding future prospects for the air shipment of perishables. It is stated that fruits and vegetables are not intrinsically air-cargo commodities but that flowers come closer to meeting the common criteria of today and tomorrow. Shippers' problems and the cost of shipping perishables are discussed. *American Aviation*, December, 15, 1944, page 72.

Airfreighting Perishables. J. Prescott Blount. The problems connected with shipping perishables by air are discussed and the numerous possibilities of air transport for this class of goods are outlined. Consideration is given to the air-freighting of meats. The writer expresses confidence that this field will offer new markets and profits. *Air Transportation*, November, 1944, pages 28, 30, 31, 60, 61, 2 illus.

A Basis for Air Cargo Rates. Part II. John H. Frederick. This is the second part of a continued article in which the writer discusses the factors upon which air-cargo rates may be based. Having considered the problem in cases where planes carry nothing but cargo, the writer discusses in this installment the factors that complicate the cost picture. It is indicated that the greatest opportunity for reducing air-cargo costs rests in the field of ground handling, which includes pickup and delivery service. The importance of speed, dependability, and convenience in the performance of pickup and delivery is emphasized. The writer believes that coordinated arrangements with existing motor carriers offer the best solution for the air lines. *Distribution and Warehousing*, December, 1944, pages 34, 36, 93.

Wanted: Uniform Air Cargo Shipping Documents. William R. Strelow. A brief commentary in which the writer gives figures showing the rapid growth in the transportation of air-borne merchandise and states that the provisions of the present airway bills are inadequate. The need for uniform shipping documents is emphasized. *Air Transportation*, November, 1944, pages 39, 40.

Air Power

Air-Warfare Review. Hanson W. Baldwin. A brief review of the current war situation refers to the prospects of jet-propulsion and rockets and includes a discussion of the use of the airplane for close support of ground forces. While generally agreeing that the close support of ground troops is one of the necessary functions of air power, the writer indicates the need for improved efficiency on the part of the U.S.A.A.F. in this type of tactic to avoid bombing and strafing of American troops. He offers the opinion that close support of ground troops depends primarily for its success upon destruction of so-called pin-point targets (gun batteries, pill boxes, field works, mortars, etc.) and maintains that area bombardment by large numbers of high-altitude bombers can prove to be more of a handicap than a help to ground forces. Major advantages of fighter bombers or low-flying light bombers for tactical use are discussed. *Skyways*, January, 1945, pages 19, 98, 2 illus.

India in the Air. Esther H. Forbes. The history of the Indian Air Force is recorded, together with details about its present status. Beginning with an account of the establishment of the Indian Air Force and a review of its training, equipment, and functions before World War II, the article tells how the early experiences gained by the I.A.F. in policing the Indian border was advantageously applied to fighting the Japanese. Information is given relative to the expansion of the I.A.F. to meet war needs, its present training program, its activities and record during this war, its personnel at present, and its current size and equipment. *Flying*, January, 1945, pages 26–28, 149, 150, 5 illus.

Air Transport

French Air Transport. Covering a period from the "fall of France" until the present time, this is a brief review of air-transport operations in unoccupied French colonial territory. Activities of Lignes Aériennes Militaires, Réseau Aériens Militaire Français, Aero-Maritimes, and Transports Aériens Français are noted. The data given include information about the routes flown by these lines and the airplanes used. *The Aeroplane*, November 3, 1944, page 505, 8 illus.

Small Town Airline. T. Claude Ryan. The President of Ryan Aeronautical Company and Ryan School of Aeronautics discusses the possibilities of an aerial pickup and delivery mail service for small towns. The plan is designed to fill the gaps in America's air-line system between large cities. Planes would pick up packages without landing so that no additional airports would be required. Proposed lines and the operations of a particular route are described. *Air Trails*, January, 1945, pages 23, 60, 64, 1 illus.

When You're Planning Payloads. James J. Heatley. As encountered on a theoretic 3,000-mile flight, this is a fuel-weight evaluation of factors that tend to disturb flight economy. Disrupting factors taken into consideration in relation to "miles made good" and "remaining fuel" include: avigational errors, turbulence, rain, unusable fuel, passenger movement, and intentional deviations from the flight path. An accompanying chart illustrates a vertical cross section of weather conditions en route the typical transoceanic flight. *Aviation*, December, 1944, pages 186, 297, 298, 1 illus.

Improving Air Traffic Control. Glen A. Gilbert. An outline of improvements that are being planned and developed by the Civil Aeronautics Administration to reduce or eliminate six basic limitations of the present system of air-traffic control in continental United States. These limitations are classified as: (1) air-ground communication limitations; (2) ground communication limitations; (3) flight-data posting limitations; (4) flight-data interchange limi-

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tations; (5) personnel limitations; and (6) procedure limitations. Developments that are described include: (1) very-high-frequency radio-range program; (2) direction-finding facilities; (3) an instrument landing system; (4) improved communications for air-traffic control; (5) improved control procedures; and (6) innovations that will aid personnel conditions. Improvements still needed are noted. *Flying*, January, 1945, pages 49, 50, 134, 136, 3 illus.

Calculating the Effect of Airport Spacing. Part III. Capt. Giles M. Reed. This is the concluding installment of an article dealing with the effects of airport spacing on air-line income. Calculations are given for estimating the revenue and the effect of cruise velocity. Tables contain formulas for determining such factors as range, efficiency, carrying power, pay load, fuel, and others. Graphs show permissible spacings and distances between refueling stops. The writer demonstrates the application of the equations developed and indicates their value for determining the transport types required. *Air Transport*, December, 1944, pages 48, 51, 52, 55, 56, 4 illus.

Give Operators More Cruise-Control Data. James B. Rea. A consideration of the importance of having manufacturers of transport planes supply operators with basic flight-test data and derivative cruise-control charts for establishing economical cruise-control techniques. In discussing the basic engineering data required for determining range and cost information for various cruise-control techniques, the writer cites the following as necessary: speed-power characteristics; engine characteristics (including fuel consumption information and manifold pressure), and propeller characteristics. He then shows how charts based on this data can be applied to obtain information for any of the following cruise-control techniques: (1) maximum range speed; (2) constant amount, or per cent, of air speed greater than maximum range speed; (3) constant b.hp.; (4) constant indicated air speed; (5) any combinations of the foregoing. *Aviation*, December, 1944, pages 184, 185, 298–300, 4 illus.

Civil Aviation After the War. P. A. Norlin. The Managing Director of Swedish Intercontinental Air Lines expresses his views on political and economic aspects of postwar commercial air transport, examining its competitive position in relation to other forms of transportation. While he states that air transport has inherent potentialities for great development after the war, he dwells more upon its limitations. Reasons are given for his belief that air transport constitutes no serious danger to surface-shipping interests. Primary among these are problems of international air-traffic agreements and the relatively higher costs of air operations. In his discussion, the writer indicates the type of airplane he considers likely to be used for future intercontinental air-transport services.

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Plants: Cleveland, Columbia City, Ind., Los Angeles

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Preceding the commentary on the future developments of air transportation is a résumé of its status before the war. This includes conditions that prevailed regarding permission to fly over foreign countries, subsidies, incomes derived from air-line operations, costs of operation, and commercial aviation's relations to other forms of transportation. Although specific allusions are made to Swedish operations, the article for the most part is concerned with air transport in general. *The Aeroplane*, November 3, 1944, pages 498, 499.

Airplane Descriptions

The Naugle Lightplane. A description is given of the structural features of the Naugle two-place, all-metal light plane designed to meet the demand for a small, inexpensive airplane of satisfactory performance. The construction of the various components is described in considerable detail, including the method by which the correct contour of the wing is formed automatically without the use of built-up ribs, thus eliminating the use of separate jigs and the assembly of many small pieces. This type of wing is reported to be less expensive to build than the conventional tapered wing and compares favorably in cost with the straight rectangular type.

The principal dimensions of the plane are as follows: overall length, 20 ft. 1 in.; wing span, 30 ft.; wing area, 123 sq.ft.; height, 6 ft. 8½ in.; wing chord at centerline, 80 in.; wing chord at tip, 32 in. The illustrations include photographs of various parts and drawings of the fuselage and wings. *Aero Digest*, December 15, 1944, pages 85–87, 9 illus.

German Jet Fighters in Operation. Design and performance details are given about three German jet-propelled fighters—the Messerschmitt Me 163, the Me 262, and the Heinkel He 280. The two Messerschmitt jet fighters are said to differ substantially from each other. While the Me 262, like the He 280 and Allied units, burns some normal form of liquid fuel with oxygen from the air, the Me 163 employs a special liquid chemical fuel containing its own oxygen for combustion. The Me 262 has two power units, one under each wing, and its air frame includes the normal tail surfaces; whereas the Me 163 rocket jet fighter employs a single power unit in the rear of the fuselage and has no horizontal tail surfaces, although it retains a single fin and rudder. Control in the Me 163 is taken care of by differential ailerons on sharply backswept wings, and the speed is said to be well over 500 m.p.h., its climb "terrific," but its range extremely short. Powered by two axial-flow turbojet units of Junkers manufacture, the Me 262 is credited with a more useful range and duration and a speed of about 500 m.p.h. It also has a novel feature by which the teardrop cockpit cover, seat, pilot, and parachutes can all be catapulted out of the aircraft in an emergency.

The He 280 is described as being similar to the Me 262. However, its jet units, although outwardly similar, are of different make and design, and it has twin fins and rudders on a tail plane with dihedral angle. Its wings are elliptic with pointed tips; its speed is thought to be slightly less than the Me 262; and it employs the same pilot-ejector device as the Me 262. *Flight*, November 16, 1944, pages 526–528, 5 illus.

Neutral Warplanes. Some brief information about the organization, history, and equipment of Sweden's air force accompanies several photographs of two Swedish combat aircraft types. The planes illustrated are the Svenska B-18 medium bomber and the J-22 single-seater fighter. *Air News*, December, 1944, page 43, 6 illus.

Aeroplanes of the Imperial Japanese Air Forces. A brief review is given of available information concerning new types of Japanese combat aircraft and of a new 18-cylinder twin-row radial engine. The latter is described as the Homare 21, developing over 2,000 hp. and having a smaller diameter than corresponding British and German engines. It is stated that many of the new types are good airplanes and a few are excellent and may prove a serious threat to present Allied superiority if operated in large numbers. Accompanying the review are three-view silhouettes and photographs of four of the new types and a table listing the first-line and second-line operational aircraft of the Japanese Army and Navy. The table gives the officially adopted code names, based on the names of boys and girls; the name of the manufacturer; the service and year; engine details; span; length; duty; and remarks. *The Aeroplane Spotter*, November 30, 1944, pages 282, 283, 8 illus.; "Japanese Aircraft," *The Aeroplane*, November 24, 1944, pages 590, 591, 8 illus.

Civil Anson. A description is given of the civil version of the Avro Anson which has been prepared for postwar use. Designed to meet the needs of feeder lines and air-taxi service, this airplane will carry a crew of two and six passengers, besides a reasonable amount of luggage. It is powered by a pair of Cheetah XV engines with Rotol two-bladed constant-speed propellers and has a hydraulically operated undercarriage. The gross weight is reported to be 9,500 lbs., while the cruising speed is placed at 150 m.p.h. *Flight*, November 9, 1944, page 503, 4 illus.

The Bristol Freighter. The postwar air freighter planned by the Bristol Aeroplane Company is described. This is a high-wing monoplane with fixed undercarriage and two Bristol Perseus engines of about 1,000 b.hp. each, placed on the wing. With an initial gross weight of 27,500 lbs., the plane will have a disposable load of 10,000 lbs. Its actual pay load for a range of 300 miles is quoted as 9,000 lbs. Cruising speed is estimated at from 120 to 150 m.p.h. The hold will have a capacity of about 1,700 cu.ft., with a floor space of 210 sq.ft. It is expected that the operating cost of this air freighter will be 1 shilling per ton-mile and that production aircraft will be manufactured by the end of 1945. *Flight*, November 23, 1944,

To investigate new ideas in setting control and stability characteristics, Beech Aircraft Corporation engineers modified the AT-10 Beechcraft plywood transitional trainer and equipped it with a so-called "Butterfly" tail. It is claimed that the new tail gives excellent control and stability characteristics at all speeds, although pilots have to be trained in the use of the tail.

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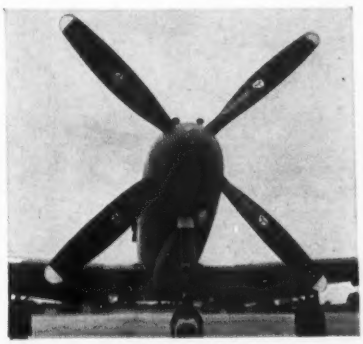

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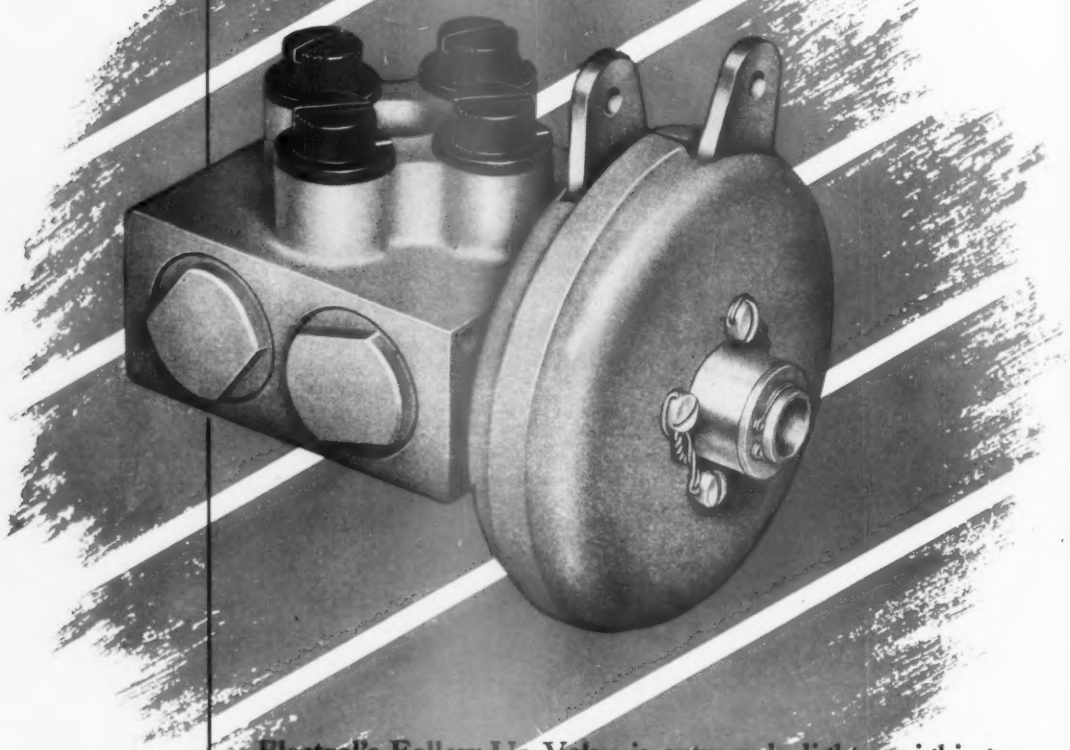

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pages 555, 556, 2 illus.; "The 'Bristol Freighter' Aircraft," *The Engineer*, November 24, 1944, pages 418, 419, 2 illus.; "Bristol Freighter," *The Aeroplane*, November 24, 1944, page 584, 2 illus.; "Air Cargo at Low Cost," *Modern Transport*, November 25, 1944, page 7, 1 illus.

Wings Over the Red Army. A brief review of Russian combat aircraft and engines. Among the aircraft noted are the I-15, 16; MIG-3; YAK-1, 4, 7, 9; LAGG-3; PE-3; SB-3; TB-7; IL-2, 3, 4; SU-2, 3; LA-5 and LA-7. The engines mentioned include the M-35A, 36, 38B, 82, 88, 100, 105, and 105R. *Skyways*, January, 1945, pages 52–55, 14 illus.

Data on XB-19 Installations Aid Army's Big Plane Program. Alexander McSurely. A brief article tells how flight-test data on experimental installations in the world's largest land plane, the Douglas XB-19, now rechristened the XB-19-A because of extensive alterations, are proving a valuable addition to the A.A.F.'s store of knowledge about big airplanes. It is explained that four liquid-cooled Allison 3420 engines are mounted in the wings. Each engine is rated at 2,600 hp. and turns a four-blade, 18-ft. 2-in. Curtiss Electric propeller. Modifications that have been made in the original equipment are described. *Aviation News*, December 25, 1944, pages 9, 10, 1 illus.

Beech Test Plane Uses V-Type Tail. A brief description is given of an experimental airplane that is featured by a tail that has neither horizontal nor vertical surfaces. The airplane is a modified AT-10 Beechcraft plywood transitional trainer, converted to a flying test unit for various advanced ideas. It has a V-shaped tail with only two elements. The purpose in building this experimental unit was to investigate the possibilities of simplified structures, of elimination or reduction of compressibility effects at high speeds, of simplified controls, and the effect on control, stability, and handling ease which may be offered by such a departure from conventional construction. *Aviation News*, January 1, 1945, page 26, 2 illus.

New Jap Fighter, Bomber Models to Make First Appearance in 1945. In this article it is stated that many new Japanese fighters and bombers are coming into action, though they are not yet seen in considerable numbers. Engines for these new warplanes are said to include an 18-cylinder radial type of 1,800 hp. which is in full production, and another of 2,000 hp. in limited production; these are top ratings with "water injection" (water and methanol). Higher ceilings are said to be in sight with the development of a two-stage, two-speed supercharger, soon expected to be in operation on at least one new fighter. Armament is much heavier, including 20-mm., 30-mm., and 37-mm. cannon, with heavier armor plate and bullet-resistant glass in some models. The new types are named and compared with their American counterparts. Statements by the Secretary of the Navy, Vice Admiral Mitscher, Admiral Ramsey, and General Kenney are reviewed. *Aviation News*, January 1, 1945, page 21. "Jap Air Force Puts New Planes in the Air," by Devon Francis, *Popular Science*, January, 1945, pages 67–73, 234, 238, 13 illus.

Airports and Airfields

It's What You Do Before It Snows. Instructions are given on how to prepare motor vehicles for the work of removing snow from airports. The article includes maintenance particulars relative to replacing double rear tires with single ones; putting chains on wheels; clutch-pedal and brake adjustments; adjustment of gears and differentials; proper greasing and inspection of transmission, stearing gear, axles, wheel bearings, etc. Efficient methods of attaching the snowplow and ballasting the truck are also noted. *Aviation*, December, 1944, pages 146–148, 8 illus.

Asphalt. Charles Pound. The part asphalt is playing in the construction of temporary and permanent airfields in the war zones and its advantages for military airfields are described. It is explained that when a temporary runway is intended for fighter use, an asphalt-treated paper and cloth surfacing material is put down by machinery in overlapping strips. It is stated that with this material it is possible to surface a runway 150 by 3,600 ft. in about 15 hours. When bombers are to use the runway, a steel surface is used. *Air Tech*, January, 1945, pages 28, 29, 74, 4 illus.

Airfield Lighting Standardization. W. E. Pennow. This is a survey of the standard equipment that has been evolved by the U.S. Army and Navy air forces for lighting airports. It lists the present AN types of marker lights, indexing the component parts, explains the functions of the basic units, and indicates the standard equipment that is now used for the purpose. The airport uses described for marker lights include: airport boundary light; airport range light; obstruction light; wind-cone marker light; wind-tee indicating lights; duplex landing-direction indicators; duplex obstruction lights; disconnecting duplex obstruction lights; intermediate airport-approach lights. For lighting the boundaries of airports, three additional uses are given: intermediate airport boundary lights; intermediate airport obstruction lights; and duplex airway obstruction lights. *Aero Digest*, December 15, 1944, pages 102, 230, 2 illus.

Do Runways Limit Plane Size? Kurt Rand. Opinions of engineers are reported affirming the belief that runways can be built to support any aircraft contemplated. It is stated that the only limitation on runway construction which can be foreseen for the immediate future is the matter of cost and that in only a few locations might subgrade conditions make the cost extreme. Individuals quoted include: Earl F. Kelly, Chief of the Division of Physical Research of the Public Roads Administration; A. C. Benkelman, P.R.A. Research Specialist; Paul H. Stafford, of the C.A.A.'s Airports Division; Edward Warner, Vice-Chairman of the C.A.B.; James A. Kelley, Jr., P.R.A. Engineer; and Harold Allen, Senior Materials Engineer. Reference is made to statistics compiled on the runways of New York's Idlewild Airport and to the C.A.A.'s *Design Manual for Airport Pavements*. *Flying*, January, 1945, pages 69, 70, 142, 146, 3 illus.

Building Airport Revenue. Dudley M. Steele and Kenneth Coryell. One section of this article discusses airport management and the other airport maintenance. The first section explains how a study of the merchandising methods used by department stores and railroad terminals will provide airport managers with helpful ideas for expanding the air-transport terminal's potential sources of revenue. Charts and illustrations show the organization and operation of the Lockheed Air Terminal at Burbank, Calif. The second section describes the maintenance of the various departments of the Lockheed Air Terminal and the field and grounds. *Aviation Maintenance*, December, 1944, pages 46–51, 164, 166, 168, 172, 174, 176, 178, 184, 188, 11 illus.

British System of Aerodrome Lighting. M. Gaughan. After a review of British prewar practices with regard to the lighting of airports, consideration is given to probable future trends in airport-lighting methods. The outline of prewar practices is based upon the 1937 revision of B.S.S. No. 563 and describes the kind of lighting equipment and installations required by this specification. In the discussion of future trends, several factors that will influence the course of airport-lighting development are included: war-sponsored improvements, both in the equipment actually used for airports and in lighting technique in other fields; developments made by other countries, both Allied and enemy; modifications that will be necessary because present lighting systems have been designed with black-out restrictions as a prime feature; and the increased illumination that will be needed on airports because of corresponding increases in street lighting, signs, and floodlighting during peacetime. *Commercial Aviation*, November, 1944, pages 110, 112, 3 illus.

Two Views on Contracting for Airport Management. C. L. Willis and Matt J. Ryan. In a two-part article, the district C.A.A. airports engineer at Fort Worth and the manager of a small Minnesota airport offer their respective opinions regarding the arrangement and conduct of contractual relationships between the municipality and the airport operator. The airport manager contends that there should be a division between airport operation and airport management, with the community re-

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serving for itself the right to manage the airport either through an employed manager with no other airport interest or through an airport management committee on the city council. It is his belief that all matters relating to the use, maintenance, and revenues should be handled by this manager or committee. He also maintains that the community should not grant exclusive use of the airport, enter into long-term leases at low rental, give away gas franchises, give away field use, give away control over building areas, give control over use of the field, or permit subleasing without specific consent. Both writers stress the importance to the community of deriving adequate revenue from the leasing of airport facilities. *Airports*, December, 1944, pages 32–34, 2 illus.

Landing Facilities for Personal Aviation. Joseph F. Geuting, Jr. The planning of landing facilities for personal aircraft is discussed by the chairman of the Personal Aircraft Council of the Aeronautical Chamber of Commerce of America, Inc. An outline is given of an intensive study of civilian flying requirements which has been made by the Council. Terminology advocated to foster a better understanding of "private flying" is included. The term "airpark" is suggested for a community landing facility for nonscheduled or personal aircraft. Certain basic facts that are stated to be evident are: (1) Aircraft for personal use can have no utility without adequate landing facilities; (2) the landing facilities that are required for personal aircraft are relatively simple and need not be either large or expensive; (3) communities, in planning landing facilities for personal aircraft, should confine themselves primarily to the landing facility. Landing facilities for personal planes are community responsibilities in the same sense as are roads and streets. *Aviation Maintenance*, December, 1944, pages 66, 67, 142, 144, 6 illus.

An Airport Plan for Volume Private Flying. G. C. Roberts. Details are given on a copyrighted plan for a 160-acre airport designed for nonscheduled and private aviation. With reduction of traffic congestion the main objective of the design, it is estimated that the discussed airport can accommodate from 240 to 300 planes per hour. The plan calls for four runways in four directions, or a total of eight runways, four of which can be used at the same time. Planes taking off would use the two runways into the wind beginning at the boundary of the field, while planes landing would use the two runways beginning at a short distance from the boundary of the airport. All runways would be 1,945 ft. long and 100 ft. wide; the control tower would be located in the center of the field; and hangar areas would be segregated from the main traffic operations. The airport is designed for stage construction so that one hangar area and one runway in each direction can be built, with other hangar areas and runways being added as needed. A diagram of the proposed airport illustrates the scheme. *Airports*, December, 1944, pages 20, 21, 1 illus.

The irregularity of receipt of publications from abroad necessitates the review of articles in issues several months late. This is done to provide readers with information regarding foreign technical progress as soon as the issues are available in the United States.

Airport Development, a Prerequisite to the Post-War Air Age. Number one in a series of articles presenting the major factors involved in the planning, design, and construction of the many types of landing facilities that will be required for postwar flying. This introductory article summarizes the progress made in airport development to date. It also briefly indicates some of the principal problems to be considered in future development. The commentary includes reference to air terminals, landing areas for helicopters, "flightstops," air harbors, and flight strips. It discusses the airport-building programs that have been suggested by the C.A.A., as well as the plans sponsored by the Personal Aircraft Council of the Aeronautical Chamber of Commerce of America, Inc., programs initiated by various states, and the "Federal Aid Airport Act" introduced in Congress. *Aero Digest*, December 15, 1944, pages 51–55, 223, 225, 9 illus.

Building the Small Airport. Robert C. Blatt. This is the first of a series of articles devoted to the various phases of small airport construction. It discusses the planning and selection of the site for the type of airport used for private flying which is classified by the Civil Aeronautics Administration as a Class 1 airport. *Aviation Maintenance*, December, 1944, pages 58–61, 140, 142, 2 illus.

Concrete Overlays for Airfield Runways. This article describes how the concrete runways for a recently built Civil Aeronautics Administration airfield in Kentucky were strengthened to carry heavy aircraft. Reinforced concrete overlays were superimposed on the original pavement, with an intervening $\frac{1}{2}$-in. asphalt cushion to prevent bond. Information is also given regarding the expansion of an adjoining modification center to accommodate increased plane production. This work included enlargement of a timber-framed building and a new steel-framed hangar. Details are included with regard to the quantities of materials used, the methods followed, and the problems solved. *Engineering News-Record*, December 14, 1944, pages 80–83, 6 illus.

One-Day Airport. Mary Conn Brown. An account is given of how a civilian landing field with two runways was constructed in one day by a Civil Air Patrol squadron. The site of the field is Redmond, Ore. *Western Flying*, December, 1944, pages 68, 70, 4 illus.

Service and a Paintbrush Bring and Hold New Business. William D. Strohmeier. Methods by which Hawthorne Airmotive increased its flying service operations at Jennings Airport are reviewed. Among the factors noted as instrumental in the growth of the business are: improvements in the neatness and attractiveness of the premises; establishment of a parking line to assure orderly parking of planes on the field; proper and immediate servicing of planes when they land; ways of obtaining different types of flight students; efficient use of available hangar space and addition of portable hangars; modern equipment for maintenance needs; a working arrangement with instructors of the Army primary school which helps to solve problem of personnel shortage; provision of comfortable, inexpensive lounging quarters for visitors; refreshment services; employment of a two-way traffic pattern; and proximity to city limits. *Aviation*, December, 1944, pages 194, 195, 265, 266, 269, 271, 272, 5 illus.

Air Fields for Farmers Pay Out. John M. Hagen. The utility and revenue-producing possibilities of the airplane for rural communities are indicated by the experiences of one farmer who built a simple airport on his farm. Although the airfield and the hangar were constructed solely for the farmer's own use, it is related how the interest they engendered almost forced him to operate the field on a commercial basis. *Airports*, December, 1944, pages 19, 49, 1 illus.

Armament

Problems of the Muzzle Brake. Camille Rougeron. A description is given of means for lessening the effects of gun recoil in tanks and airplanes. One such device is the muzzle brake. It is explained how the use of the muzzle brake has made it possible to equip both aircraft and tanks with armament of a power greatly exceeding anything previously attained. Muzzle velocity is defined and a formula is given for calculating the pressure of recoil. The principle on which the muzzle brake operates and problems connected with its use are discussed. Consideration is given to the comparative effect of a muzzle brake on guns with different muzzle velocities. *Aeronautics*, December, 1944, page 72.

Q. F. Mosquito. Some details are reported about six-pounder gun installations that have been used on Mosquito XVIII planes. Mounted below the four 0.303-in. machine guns in the nose of the Mosquito, the six-pounder fires shells in quick succession as the aircraft dives to attack. This installation is said to have been employed with marked success against U-boats. *Flight*, November 23, 1944, page 564, 2 illus.

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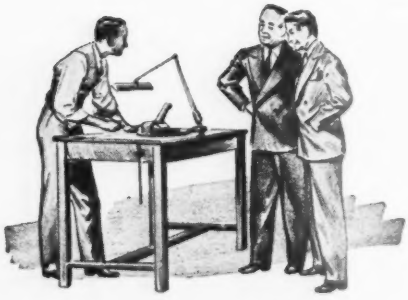

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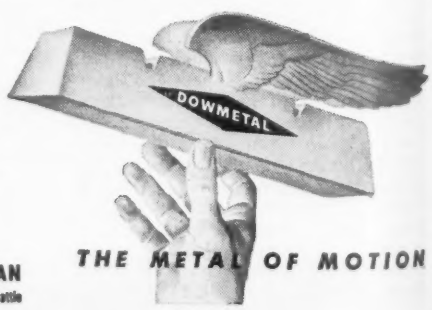

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Business and Finance

Aircraft Stocks Climb Out of Bear Pit. Raymond L. Hoadley. The writer analyzes reasons for a reported reversal of Wall Street's "bear" attitude toward aircraft equities. He attributes present and anticipated rises in the values of aircraft stocks to air-line orders for planes to be delivered on a "When-as" basis; potential foreign markets; improvement in the industry's reconversion situation; improvement in the financial positions of the aircraft-manufacturing companies; favorable dividend situations; the likelihood that the transition to peacetime operations will be in easier stages than originally expected; and the growth possibilities in future aviation as evidenced by the confidence in postwar designs which has been shown by personal-plane producers. *Aviation*, December, 1944, pages 187, 262.

So You Want to Be a Fixed Base Operator. Joe Chase. The prospective fixed-base operator is warned of some of the financial pitfalls to be avoided in the conduct of such a business. In reviewing some of the costs and income problems, the writer divides the problems into three groups: investment, organization, and general. He advises how to gather into an outline all the information available about the proposed fixed-base operation; tells how to analyze the "market"; suggests what factors have to be considered (including the amount of capital, volume of business, competition, overhead costs, income expectations, etc.); discusses the question of whether to operate as a corporation, partnership, or sole proprietorship; and examines the financial aspects of the business as interpreted by an accounting system. *Air Pilot and Technician*, December, 1944, pages 30–32, 4 illus.

Civil Aviation

Designing for the Customer. J. G. Willis. The writer expresses the view that in civil aviation the customer is more interested in comfort and safety than he is in the efficiency and performance of the aircraft. It is emphasized that if air transport is to be sold to the public, airplanes must be made not only to *be*, but to *look*, safe and comfortable. It is also stated that more attention should be given to points of maintenance and serviceability. *Aircraft Engineering*, November, 1944, page 326.

Hang Your Shirt on a Star. The usefulness of the airplane as a sales aid in other businesses is illustrated by this account of how one clothing manufacturer has designed his products, advertising, and sales promotion around flying activities. Besides developing his line of sports clothing for flying and naming all styles after flight maneuvers, this manufacturer employs salesmen who make contact with their customers by plane. Also, planes converted into "flying show cases" permit the products to be demonstrated at the airport. *Aviation*, December, 1944, pages 125, 261, 2 illus.

The Proposed New Civil Air Regulations. Wolfgang Langewiesche. The writer's opinions are offered with regard to the proposed new Civil Air Regulations. Regulations on which comments are made include those pertinent to division of the air space into three classes for purposes of traffic regulations and weather rules; flying in practically any weather as long as the flight is below 800 ft.; elimination of minimum flight altitudes; visibility requirements; control zones; traffic clearance; bad-weather pilotage; licensing of pilots; flight tests for private pilot's license; horsepower ratings; connected dual controls; business use of private airplanes; commercial flight tests; instructors' ratings; instrument ratings; and requirements for directional gyros and power-driven pumps for instrument flight. On the whole, the proposed regulations receive the commendation of the writer. *Air Facts*, January, 1945, pages 59–81.

Control Equipment

Considerations in Servomechanism Design. S. W. Herwald. Methods are outlined by means of which the steady-state and transient performance of servomechanisms can be calculated. A general solution in operational form is given, and specific solutions are derived for a number of different types of angular-position servomechanisms. Among these is the solution for the Ward-Leonard type of control with antihunt feedback, which, it is noted, is probably the most common type of angular-position control. *Electrical Engineering*, December, 1944, pages 871–876, 8 illus.

Solenoid-Operated Control Valves. V. W. Eckel and O. H. Wisegarver. This paper describes a type of device designed to make possible the utilization of some of the best features of hydraulic and electric systems for the actuation of controls. The advantages of the electro-hydraulic system are outlined. Details are given about the remotely controlled, electrically operated hydraulic valve, that is stated to make the electrohydraulic system practicable. Both the valve design and the solenoid design are discussed. It is concluded that considerable savings in installation weight may be effected by electric remote control of hydraulic valves, particularly when the accessory to be controlled is placed at a distance from the cockpit. It is stated that it may be necessary to sacrifice simplicity and low valve cost to obtain the minimum overall weight and dollar cost. The analysis indicates that solenoid valves should be designed for low-operating forces and efficient electrical and mechanical elements, not so much because of the electric power requirements but to decrease heat dissipation and, consequently, size and weight. *Electrical Engineering*, December, 1944, pages 911–914, 10 illus.

• **Electrical Control in Automatic Pilots.** C. M. Young, E. E. Lynch, and E. R. Boynton. Automatic-pilot principles are summarized, and a description is given of some of the unique and less understood features of a specific model of automatic pilot with electrical control. A detailed description of the instrument is given. The theory of automatic-pilot operation is briefly analyzed in an appendix. *Electrical Engineering*, December, 1944, pages 939–943 (Transactions), 12 illus.

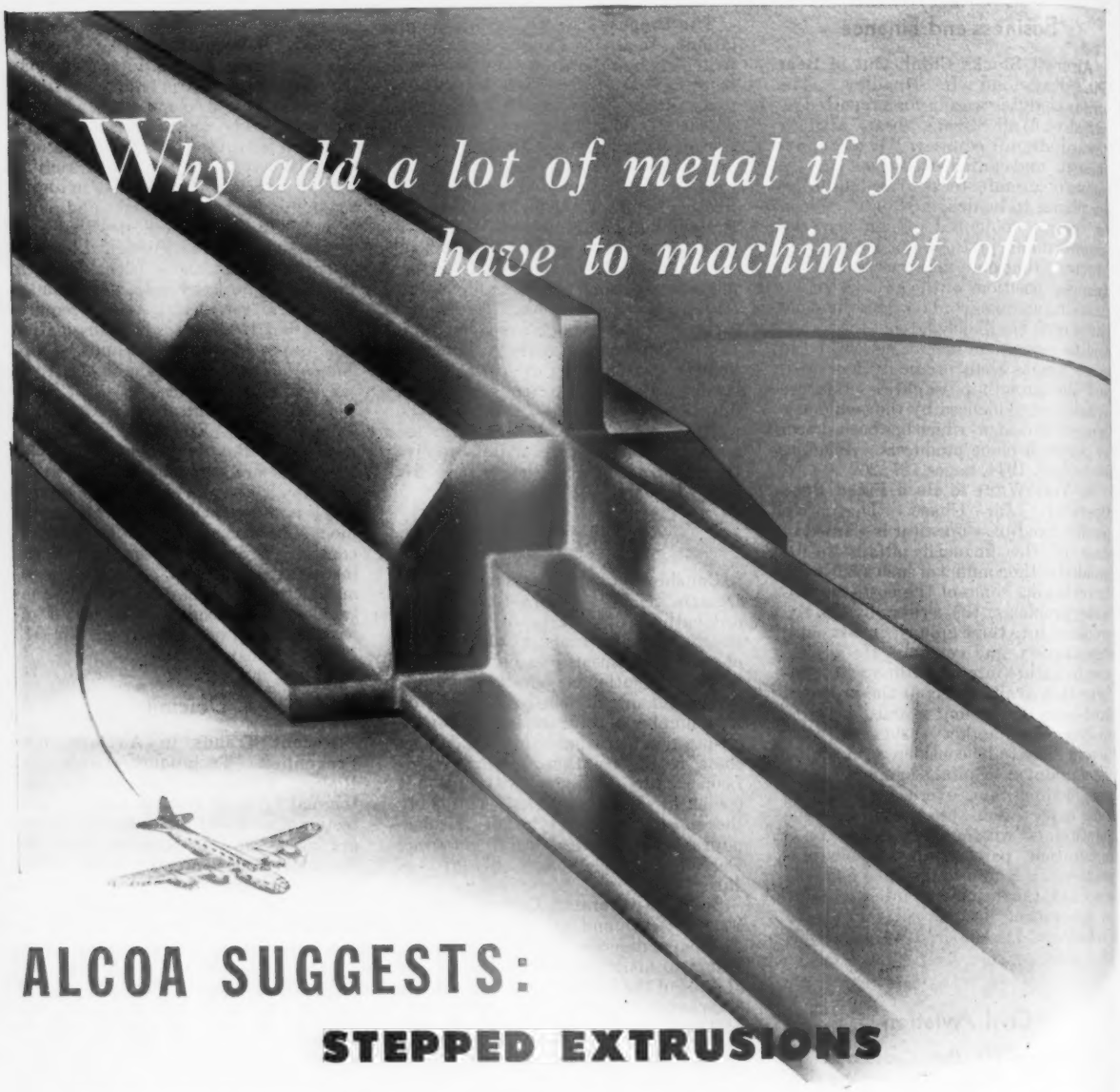
Deicing

Recent Trends in Airplane Ice-Prevention Technique. Lewis A. Rodert. The mechanical, chemical, and thermal types of systems used for protection against ice formation on airplanes are discussed. It is noted that the thermal systems are the most widely used. Surface heating appears to be the most satisfactory method of protecting carburetors, propellers, wings, and the empennage from ice formation. It is shown that despite the use of improved methods of ice prevention, full benefit cannot be realized from their use until radio facilities and instrument landings have been developed further, for flights must now be canceled because of limited visibility even if icing conditions do not prevent flight. *SAE Journal*, December, 1944, pages 586–591 (Transactions).

Design

Faithful Annie. Senrab. A brief history of the Avro Anson. Its genesis is traced from the Avro 504 and the Fokker D.VIII, through the Avro 618, "Ten," 619, "Five," 620 "Six," 642, 652, and to the variants of the Anson. Successive developments that resulted in the Anson I, II, III, IV, V, VI, X, XI, XII, and XIX are described. Statements are also given on manufacturing processes that were used in the production of these aircraft and the factories that were assigned to build them. A supplementary table lists the engines, span, length, wing area, loaded weight, and maximum speed of each model. This table also contains remarks about the special features and purposes of the successive types. *The Aeroplane*, November 17, 1944, pages 557–560, 20 illus.

The "Liberator" B-24J. Part II. In this article describing the design and construction of the B-24J, structural details are given on the seven compartments into which the fuselage is divided. Features of the landing gear, propellers, engines, lubrication and fuel systems, controls, anti-icer and deicer equipment, and electric and hydraulic systems are examined. The design analysis also includes data about the signal equipment, oxygen system, interphone system, and radio system carried by this recent version of the Consolidated Vultee Liberator bomber. Schematic drawings and



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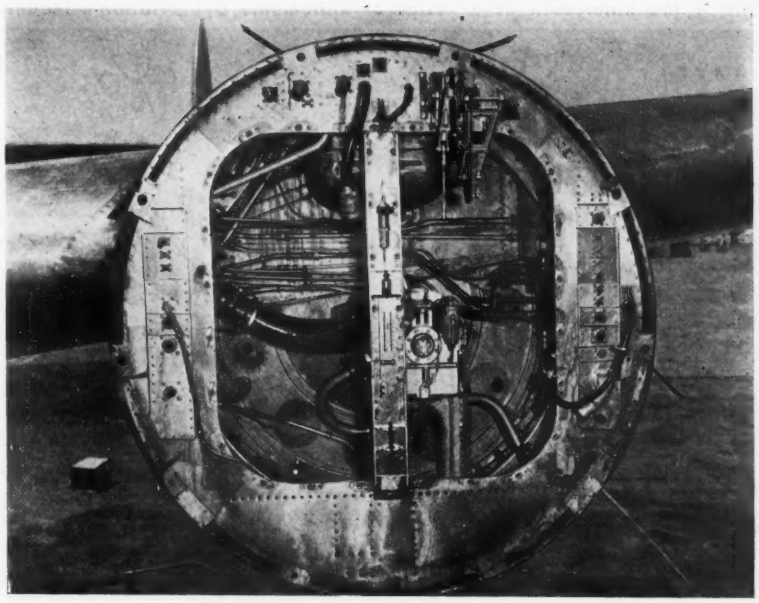
photographs of the various parts illustrate the text. *Aero Digest*, December 1, 1944, pages 74–79, 12 illus.

A Letter to Santa. Mimi Cerlian. It is pointed out that if flying is to be popularized personal planes must be designed which are more adaptable for the average woman to fly. Seventeen suggestions are offered for making the personal plane easier, more comfortable, and more attractive for women pilots. Among the requisites specified for such an aircraft are: easy entrance and exit; comfortable and adjustable seats with arm rests; rudder pedals and brakes within easy reach which can be used while wearing high heels; transparent enclosures built low enough for the pilot to see the ground as well as the sky; pockets or elastic bands for storing handbags, packages, etc.; all levers to work in one direction; colored marks on the instruments to show the limits of operation; and uniform indications of increases and decreases on the instruments. Other equipment indicated as desirable are propeller-protection; self-starters, caps and gages for gas and oil where they can be easily inspected; mufflers; heaters; two-way radio; and dual controls that "aren't in the way." *Air Facts*, January, 1945, pages 20–22.

Fleet Air Arm Equipment. "Catapult." The evolution of the British two-seater naval air-arm reconnaissance fighter is traced. In discussing the factors that have influenced the design of this type of aircraft, the article describes the peculiar conditions under which carrier-based airplanes have to operate and explains the reasons for design changes that have been made from time to time. The review takes into account successive developments that were marked by the Blackburn Dart, Ripon, Baffin, Shark, Skua, and Roc; the Avro Bison; the Fairey IIIF, Swordfish, Seafox, and Fulmar; the Supermarine Walrus; the Hawker Osprey and Sea Hurricane; the Gloster Sea Gladiator; culminating in the Fairey Firefly. *Flight*, November 9, 1944, pages 500–502, 10 illus.

Assisted Take-Off. S. W. G. Foster. Driving the wheels directly from the main engines is suggested as a means for assisting an airplane forward during the initial stages of its take-off run. Two ways of accomplishing this are noted. In one the power could be transmitted through a suitably geared shaft drive on similar lines to the one employed on the autogiro for accelerating the rotor blades before take-off. A clutch unit interconnected with the brakes enables an accelerating or a retarding force to be applied at will. The second method is by storing the energy given by the engine electrically, pneumatically, or hydraulically and applying it to the wheels as required.

The advantages of such a scheme are cited as a shortened take-off run, higher wing loadings, possibility of using smaller airdromes, and improved possibilities for ground maneuvering. Its main disadvantages are reported to be weight of drive, requirement for stronger undercarriages, and the need for a different take-off technique. *The Aeroplane*, November 10, 1944, page 536, 4 illus.



The engine mount for the Lockheed Constellation is so designed that an engine can be installed in approximately 30 min. Note the ten holes for the engine bolts about the perimeter of the nacelle. The design of the nacelle also facilitates quick attachment of power-unit electric cables, control cables, and hydraulic lines.

The Martin Marauder B-26. Roger Ward and Phelps F. Mace. Design features of the B-26 Marauder are analyzed, and the construction of the major component parts is described and illustrated. Details are given about the fuel system, the operation of the bomb-bay doors, brakes, surface controls, and other equipment. *Air Tech*, January, 1945, pages 17–27, 68, 19 illus.

Design of Hat-Type Plate-Stringer Combinations. Henry L. Langhaar. In this article charts are shown for use in the study and selection of compression panels stiffened by hat-type stringers. It is explained that these charts were constructed with the aid of a semi-rational computation procedure described in an article by the writer titled "Buckling of Aluminum Alloy Columns and Plates," appearing in the *Journal of the Aeronautical Sciences*, Vol. 10, No. 7, July, 1943. In the investigation use was made of column curves given in Consolidated Vultee Report No. SG-984. Because the computation method involves certain empiric assumptions, the writer presents a discussion of its accuracy. *Automotive and Aviation Industries*, December 1, 1944, pages 28–32, 103, 104, 15 illus.

The Scientific Basis for the New British System of Cockpit Lighting. Edward S. Calvert. Principles involved in the design of a dual system of cockpit lighting, as well as some details of the fittings, are given in this article. This British system uses ultraviolet radiation for the illumination of the instrument markings and red floodlighting for the general illumination of the cockpit. Particular emphasis is placed on correct layout of the cockpit, which is regarded as the most important single factor for the success of the system as a whole. *Electrical Engineering*, December, 1944, pages 869, 870 (Transactions), 1 illus.

Significant Engineering Developments in Aircraft Design. Warren Furry. The theoretic, experimental, and technical developments of airplane design are reviewed. Outstanding developments in aerodynamics, including airfoil and cowling shapes, wind-tunnel techniques, and flight-testing methods, are discussed. Advances in structural design and testing are traced, with comments on possible future materials. The development of aircraft engines during the last 40 years is briefly surveyed. Improvements in production methods are outlined, especially the progress made in designing so as to facilitate production. Mention is made of some of the inventions that have advanced aviation, including devices to improve the safety of flying, to extend range and altitude, and to overcome the limitations of weather conditions. *Poly Men*, November, 1944, pages 2, 3, 11.

Design Analysis of the Boeing B-17G "Flying Fortress." A lengthy analysis is given of the features of design of the Boeing B-17G. It begins with the description of the framework of the fuselage, describing the construction of each of the major components of the fuselage, and proceeds to an analysis of the wing group. Following this is a detailed description of the construction of the tail group, including the stabilizer, elevators, fins, and rudders. The details of construction include information concerning the material, the dimensions, and the processes followed in building the individual parts. The next section of the article gives information about the power plants, including the engines,

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Aviation's plans for the future range all the way from super airliners to packaged airports. But none of these plans will be translated into flight-hours or airfields or trade routes—until it is properly *sold!* And perhaps the first place for aviation to talk up its ideas is the "test pilot" market of U. S. citizens who are always ready to buy progress whenever they see it in business or in private living.

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accessories, and propellers. The lubrication system is also discussed, and a schematic diagram shows its layout. *Industrial Aviation*, December, 1944, pages 17–24, 26–28, 30, 31, 99, 18 illus.

Production Considerations in Engineering Design. A. H. Petersen. The writer outlines the aims of the production design engineer. Production considerations in redesign are discussed, and attention is given to means of eliminating close limits and small clearances. Examples of improvements effected through redesign are given and illustrated. How production economies can be achieved by designing parts so that they are simple to fabricate is described. In connection with this discussion, tables prepared by the same writer are published under the title *Standard Holes for Pins and Bolts, and Cylindrical Fits.* They give data on pin and bolt holes, applications of standard hole sizes, and cylindric tolerances. *Product Engineering*, December, 1944, pages 813–817, 7 illus.; Tables, pages 856–858.

Designed Utilization . . . It Points to Profits. Part II. Scholer Bangs. The concluding installment of an article that discusses the engineering technique evolved by Lockheed to increase potential utilization of the Constellation. The writer describes the important part the provision of quickly interchangeable parts has played in the approach to an 18-hour-per-day utilization objective. The provision of large access doors makes possible a saving in maintenance time. Quick fasteners facilitate the easy and rapid performance of maintenance operations. Reference is made to the development of new ground-handling equipment for reducing time and labor and to the design of hydraulic landing gear that can be operated by one man. A table lists the design revisions and the improvements thereby achieved. *Air Transport*, December, 1944, pages 28–37, 18 illus.

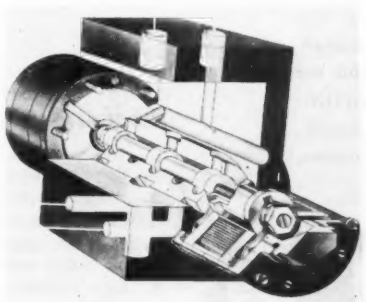
Fundamentals of Airplane Design. A. L. Klein. It is emphasized that designers and vendors of aircraft parts must give particular attention to the three underlying principles of sound engineering if they are not to violate the fundamentals of safety, weight, manufacturability, and serviceability in manufacturing aircraft. Safety requires that mechanisms continue to operate even under conditions of neglect and misuse. Weight-saving justifies a great amount of work in the engineering department and the shop. Designers must keep in mind several problems that are of the utmost importance to the airplane manufacturers. The manufacturer must schedule and keep track of a great number of parts. The parts must fit after they are made. Some operations cause parts to expand, others to shrink, making the problem of assembly a major one —made even more difficult if there are serious deflection troubles. Particular attention is advised for the provision of emergency means of operation of controls in the event of mechanical failure, such as auxiliary mechanisms for lowering landing gear, stand-by power for brakes, duplicate cables, and duplicate electric equipment. It is stated that aircraft parts must be designed for serviceability and manufacturability so that they can be produced, installed, and maintained with the greatest ease and efficiency. *SAE Journal*, December, 1944, pages 609–613 (Transactions), 4 illus.

Minimum Weight in Heat Exchanger Design. Bernard L. Messinger. This article concerns the subject of designing heat exchangers for minimum weight. The writer discusses in detail a quantitative method that can be applied to numerous heat-transfer design problems and will result in an economical expenditure of materials. He analyzes single-extended and double-extended surfaces and comments on the application of the theories to the solution of the problems of design. *Industrial Aviation*, December, 1944, pages 44–46, 48, 49, 102, 103, 7 illus.

Electrical Equipment

Design Considerations of 400-Cycle Aircraft Motors. M. B. Sawyer, Sr. Some of the problems involved in the design of 400-cycle aircraft motors of the induction type are discussed with particular reference to the work of those who write the specifications for such motors. Characteristics of 400-cycle motors, which differ radically from those of 24-volt d.c. motors, are described. The requirements of the airplane designer are listed, and the problems faced by the motor designer in meeting those requirements are discussed. The generalization that high speed means less weight per horsepower is investigated by considering the results of running a familiar 1-hp., 60-cycle, four-pole induction motor from a 400-cycle power supply. *Electrical Engineering*, December, 1944, pages 877–879, 1 illus.

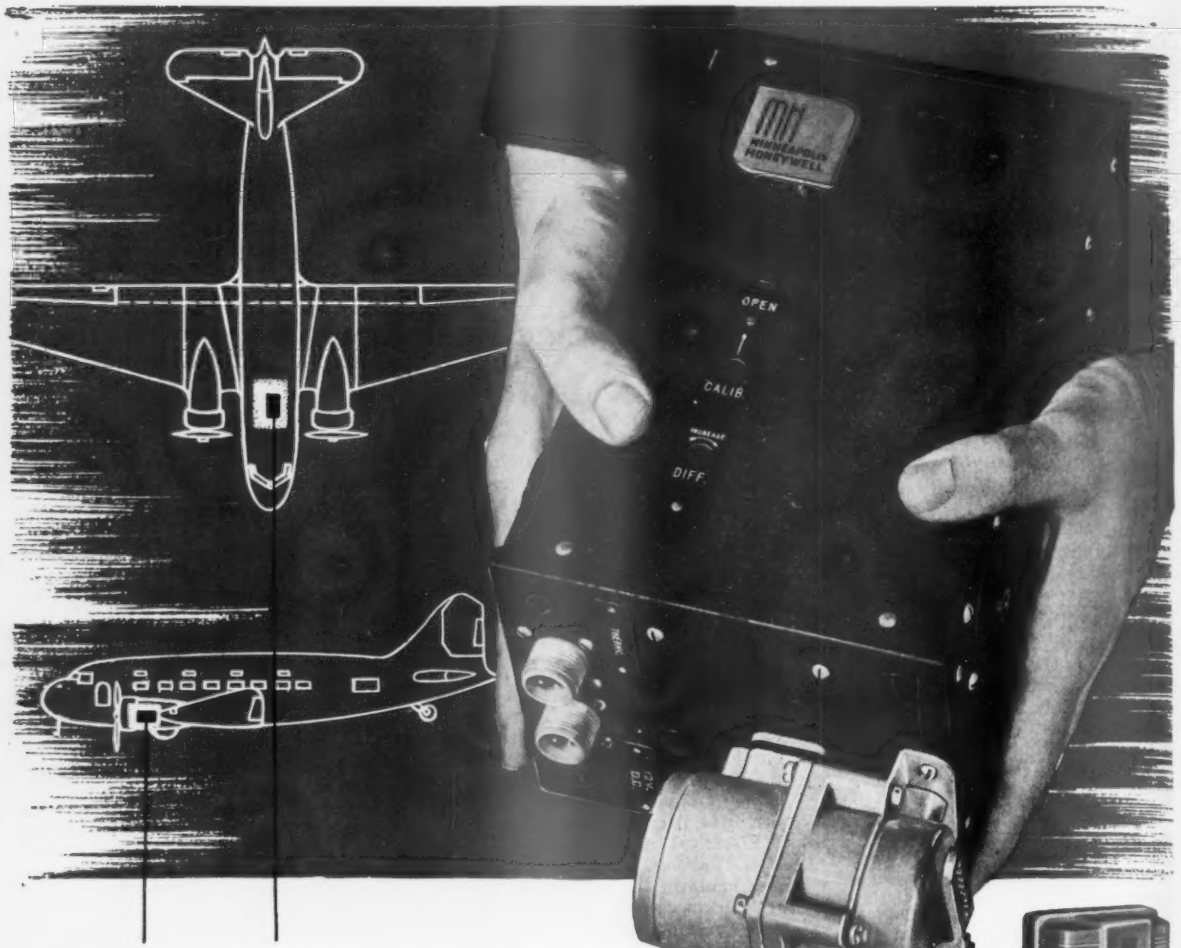
Electrical Connectors. Lt. Col. T. B. Holliday. An account of the progress made in the development of electrical connectors for aircraft, with references to Army and Navy specifications and requirements for these connectors. As an indication of the magnitude of the problem of designing a satisfactory electrical connector that can meet all of the aircraft problems, it is noted that aircraft electrical circuits often require connectors that can handle as many as 100 conductors. The range of size requirements also is wide. Reference is made to the early use for aircraft of electrical connectors developed for the motion-picture industry. Improvements in the design of aircraft connectors are described and various forms of connectors are illustrated. An exploded view of a Cannon straight-type connector, with socket insert assembly, is shown. Tables give conductor and contact data, conductor and solder cap data, and data concerning insulation and creepage. *Industrial Aviation*, December, 1944, pages 57, 58, 60–62, 101, 102, 8 illus.



A cutaway view of a solenoid-operated transfer valve for use in automatic pilots.

D-C Arc Interruption for Aircraft. J. S. Quill and L. T. Rader. A report is made of an investigation initiated to obtain preliminary data about arc-interruption problems introduced by the use of d.c. voltages higher than 24 in aircraft electric systems. The use of a newly developed timer for measuring the duration of arcing made it possible to obtain a large amount of quantitative data, which are presented. Included is information concerning d.c. arc interruption for voltages up to 250 volts at pressures from sea level to 50,000 ft. altitude. Both resistive and inductive loads are investigated. The load range chosen includes small currents corresponding to relay or auxiliary-contact values and higher currents associated with power circuits. Two general types of devices were used for the tests—namely, single- and double-break switches and a blowout-type contactor. The results are presented both in the form of maximum amperes that can be interrupted and arcing time in milliseconds. The effect of inductive loads on arc interruption is discussed briefly. Also given are the results of an investigation of the effect of a magnetic field on an arc, which at altitude tends to produce an arc movement in a direction opposite to that at sea level. It is concluded that arc-interruption problems are capable of solution for systems up to 250 volts and that perhaps 600-volt systems are possible. *Electrical Engineering*, December, 1944, pages 883–888, 22 illus.

Basic Considerations in the Selection of Generators and Batteries for Aircraft. L. M. Cobb and H. M. Winters. Reference is made to the importance of the electric system in modern aircraft, and it is stated that safety of operation is often dependent to a limited extent on the reliability of the electric system. Because of its importance, the general requirements of the electric system must be conceived for a proposed new airplane design when the design is in embryonic state. Preliminary electric-load requirements must be calculated and, as design changes are made, must be revised repeatedly in order to coordinate properly the electric-



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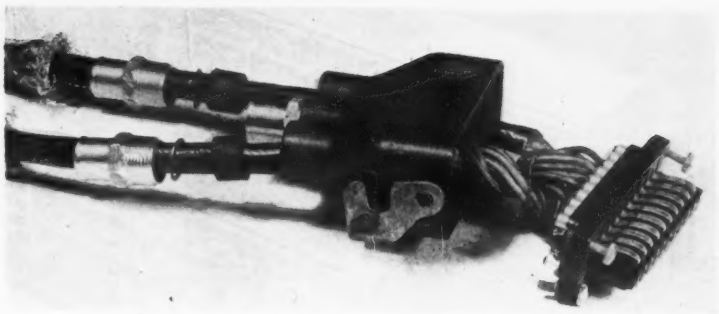
system design with the other design characteristics of the airplane. During this process of development all controlling design features of the complete electric system should be considered under operating conditions approximating as closely as possible those that would be obtained during actual operation.

A description is given of a method developed to facilitate the accurate calculation of the electric loads of an airplane in any design stage. The use of these load calculations in the selection of generators, batteries, and auxiliary power-plant generators is explained. *Electrical Engineering*, December, 1944, pages 889–893 (Transactions), 4 illus.

One Type of Rotary Magnetic Clutch and Its Associated Brake Used on Aircraft Electric Motors. Leo Andrews and Fred Shanely. Current objectives in the adaptation of clutches and braking devices to the aircraft type of electric motor and its power-transmission system are listed. It is noted that the lightweight, high-torque, high-speed electric motors developed for airplanes have brought new problems for the clutch and brake designers. A description is given of a particular type of clutch and the brake used in conjunction with it. One version of the brake is used to hold a load through the associated power transmission system after the motor has been "cut off." Another version applies to a mechanism that may be operated manually during an emergency. The clutch considered employs an application of the d.c. short-stroke clapper electromagnet. An analysis is made of the magnetic circuit, and design details are given. *Electrical Engineering*, December, 1944, pages 893–895 (Transactions), 6 illus.

Airline Aircraft Electric-Equipment Maintenance. W. A. Petrasek. This paper describes an air-line operator's methods for insuring reliable operation of aircraft electric equipment. The operation of American Airlines' fleet of 50 Douglas DC-3 transport planes is the basis of the discussion. An organization chart of the company's maintenance department shows the arrangement that has been found necessary to accomplish the job of maintaining a fleet of airplanes. An electric-equipment overhaul timetable is also shown. The trend of the engine-overhaul period from 1938 to 1944 is illustrated by means of a chart. Photographs show various electrical maintenance operations. *Electrical Engineering*, December, 1944, pages 900–905, 27 illus.

Plastics for Aircraft Wiring. A new system of electrical wiring, developed by the Technical Board of the Society of British Aircraft Constructors, is described. It consists essentially of a series of connector blocks with direct connection to the main power source. From the connector block simplified plug-in leads extend. The block is made of lightweight, strong plastics material of high electrical efficiency and so far is available in two, three, five, and 15-way units, either single or double-tiered. Thus, a two-way unit can offer four pickup points. It is explained that with the new standard wiring system, an aircraft designer can provide at one centralized point—or at any number of dispersed points—the requisite number of connector blocks with their varying numbers of leads. If, in course of time, it is found necessary to increase the number of leads, all that is necessary is to affix another connector block of the requisite capacity. *British Plastics*, December, 1944, pages 545, 552.



A typical example of a German 20-circuit connector disassembled for examination.

Electric Connections on Aircraft. F. O. Stebbins and L. A. Taylor. Factors and design details which must be considered in the designing of successful electric connections for aircraft are described. Electric connections are classified according to their service and are discussed in sections relating to permanent types, semipermanent types, quick-disconnect types, sliding connections, and operating connections. Illustrations are shown of various types of connectors, including examples of British, German, and Japanese designs. Emphasis is placed on the importance of well-designed, reliable, electric connections for safety and the successful operation of civilian and military aircraft. *Electrical Engineering*, December, 1944, pages 906–911 (Transactions), 18 illus.

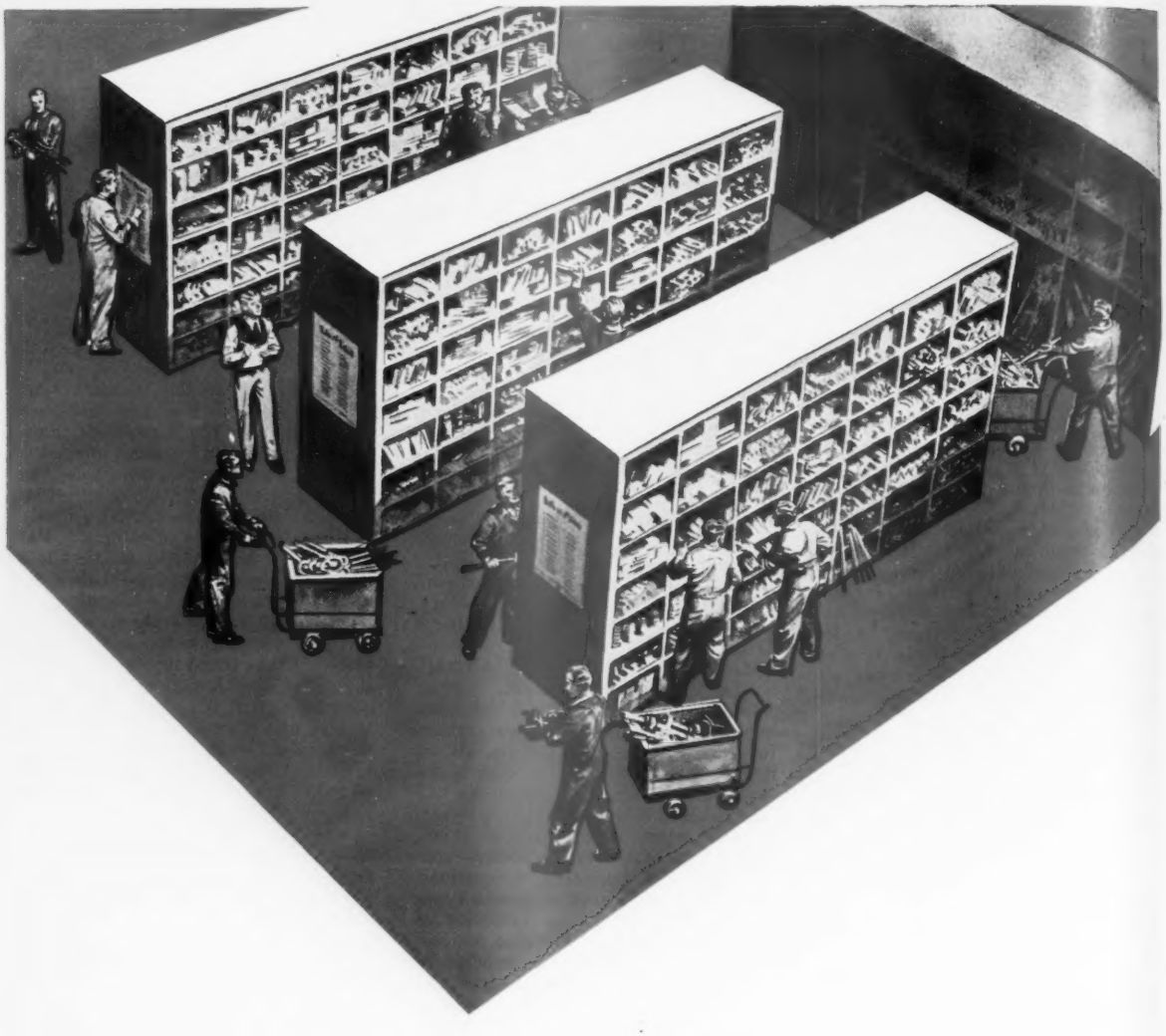
A New High-Frequency Capacitor. W. M. Allison and N. E. Beverly. This paper describes how the limitations of the ordinary capacitor at high frequencies have been overcome in part by a new three-terminal feed-through capacitor. The new device has a low impedance over a wide frequency range, enabling improved by-passing or filtering over this wide range of frequencies. *Electrical Engineering*, December, 1944, pages 915, 916, 7 illus.

Inherent Overheating Protection of D-C Aircraft Motors. Cyril G. Veinott. To provide information about how thermal protection functions in fractional horsepower d.c. aircraft motors, test data are given on a representative motor equipped with inherent overheating protection. Tests were taken on a $^1/_{15}$-hp. 7,500-r.p.m. d.c. motor; loads ranged from locked rotor to the minimum running load sufficient to trip the thermostat. Ambient temperatures ranged from −58° to +78°C. Locked-rotor and running-overload temperature tests were also taken at a density altitude of 42,000 ft. Temperatures of the winding, frame, brush holders, and bearings were measured carefully under the conditions. Satisfactory protection, without premature tripping, was invariably achieved. *Electrical Engineering*, December, 1944, pages 920–925 (Transactions), 7 illus.

Aircraft Electric Systems. Part III. R. J. Sutton and G. C. Close. The third of a series of articles about the electrical equipment for aircraft refers to the wiring. The writer does not attempt to deal with the subject completely in the current section because the wiring layout of a modern airplane is so complex that it is considered desirable to give first a general discussion of the mechanical details, such as the layout in general, the conduit layout, bonding, and shielding. The more technical details are left for a later installment.

After reviewing the transition from the simple wiring systems of earlier aircraft and the increase in the applications of electric power in airplanes, the article describes the sectional method of installation of wiring and its advantages. It is noted that conduit installations are rapidly displacing open wiring, and the rigid and flexible types of conduit are described. Advice is given for the designing of a conduit layout, with a table listing the principal wiring systems for a large airplane. The purposes of bonding and shielding are explained, and another table gives representative examples of the maximum allowable bonding resistance between specific components and the main air-frame structure. Methods for shielding electrical equipment are outlined. *Western Flying*, December, 1944, pages 63, 64, 66, 120, 4 illus.

Historical Development of Electric Connectors. Edward J. Neifing. A brief survey is made of the various stages of the development of electric-connector design and the expansion of the uses of such devices, from the earliest types of heavy-duty power service to the smaller and more intricate fittings in aircraft, electronics, sound equipment, television, and marine applications. Because of the broad scope of the subject, the material is treated in generalizations in order to encompass the history within the space limitations of the paper. The writer expresses his belief that connector design, materials, and manufacture are keeping pace with the requirements imposed by new equipment. Since the connector is essentially



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a component part of the electric device, its development is affected by advances in the design of the equipment, and its operating efficiency is increasing as a result of adaptations to new requirements. Among the improvements expected for the future are snap-in solderless contacts. Other new developments not entirely out of the experimental stages include the following: connectors having a greater voltage for high cycle; special switching devices that operate engine-starting units; and waterproof designs for marine and ordnance requirements. *Electrical Engineering*, December, 1944, pages 925–928 (Transactions), 11 illus.

The Testing of Brushes for Life and Performance Under Various Altitude Conditions. C. J. Herman. The writer describes his experience in the testing of brushes on electrical equipment built for high-altitude service on aircraft. Details are given regarding the procedure and range of conditions found useful in testing a wide variety of small a.c. and d.c. machines. The hope is expressed that a suitable test code may be developed as a supplement to the present test code for d.c. machines. It is stated that while the only real criterion of brush performance is actual experience in service, carefully conducted tests over a range of special conditions provide a good basis for brush selection and greatly expedite the final choice for the best overall performance. *Electrical Engineering*, December, 1944, pages 929–933 (Transactions), 8 illus.

Solderless Terminals. F. H. Wells and J. C. Balsbaugh. Details are given regarding tests of the electrical characteristics of solderless terminals under conditions of corrosion. One type of solderless terminal illustrated and described consists of a tongue or lug for terminal-block connection and an internally serrated barrel with sleeve for crimping to the wire. The inherent difficulties in obtaining a satisfactory soldered terminal are outlined. A description is given of the test procedure used in determining the electrical characteristics of solderless terminals. Electrical measurements of resistance were made under nine different corrosion conditions, including the use of salt sprays and sulphur dioxide vapor. The corrosion tests were made on different terminals for varying periods of time and with both a.c. and d.c. power. The results of the tests are summarized and tabulated. *Electrical Engineering*, December, 1944, pages 933–938 (Transactions), 15 illus.

Peak Voltages with D-C Arc Interruption for Aircraft. Virgel E. Phillips and Walter P. Mitchel. Reference is made to the lack of quantitative data on high-voltage peaks occurring during the interruption of direct currents in circuits having inductance, particularly at voltages, loads, and altitudes encountered in the operation of modern aircraft. The writers present experimental data on the magnitude and variations of voltage peaks set up by d.c. arc interruptions of inductive circuits. These voltages were measured on d.c. systems of 30, 60, 125, and 250 volts with currents ranging from 0.1 to 220 amp. and at simulated altitudes from sea level to 50,000 ft. The loads used included typical aircraft devices such as motor fields and contactor coils. In this investigation use was made of a cathode-ray tube with a retentive screen, so retentive that the trace of a single half-cycle sweep of a 60-cycle wave takes several seconds to disappear. By using this tube it was possible to take a large amount of data in a short time, so that, instead of relying on a few oscillograms, ten readings could be taken at each point and an average and range established for the voltage disturbances set up. *Electrical Engineering*, December, 1944, pages 944–949 (Transactions), 21 illus.

Altitude Rating of Electric Apparatus. Paul Lebenbaum, Jr. This paper studies the effect of altitude on the ratings of rotating electric machines and, after determining the fundamental principles involved, discusses these in relation to the application of such machines in modern aircraft. It is shown that the rating of a self-ventilated direct engine-driven aircraft generator decreases rapidly with altitude, and at some altitude within the operating range of the airplane the generator may be able to dissipate only its no-load losses. It is shown also that an air-scoop-ventilated direct engine-driven aircraft generator maintains its rating over most of the operating range of present-day aircraft. Certain sea-level tests are proposed from which calculations of rating under altitude conditions can be made. It is stated that the theory and tests presented have been checked by altitude-chamber studies on an aircraft-type d.c. generator. *Electrical Engineering*, December, 1944, pages 955–960 (Transactions), 5 illus.

Engines

Analytic Investigation of Problems Concerning the Flow of Cooling Air in Light Airplane Engine Installations. John R. Weske. Overall performance of light airplane engine-cooling systems is related to the characteristics of their component elements. Correlation of the effect of flow losses, thermal effects, etc., is established in terms of parasite drag and related to airplane performance. Optimum conditions of design, arrangement, and operation are derived for self-induced and blower-operated engine cooling systems, taking account of energy and weight requirements. *Journal of the Aeronautical Sciences*, January, 1945, pages 63–66, 4 illus.

The Gipsyqueen II. Part III. J. A. Oates. The third of a series of articles reviewing the methods employed in the manufacture of the de Havilland Gipsyqueen II refers to the upper portions of the engine. It describes the construction and operation of special fixtures introduced by company engineers for machining operations on the crankcase top cover and related parts. It reveals how the camshaft is manufactured, tracing the machining sequence from start to finish. Gear-production procedures are outlined and particulars are given on the final assembly and testing of the engine. Illustrations of equipment used in the various operations supplement the text. *Aircraft Production*, December, 1944, pages 563–574, 29 illus.

The Strength of Valves at Closing. W. Zalewski. It is noted that because the inertia forces act for a very short time on the poppet valve at the moment of closing, that is, when it is coming to rest on its seat, normal considerations in the strength of valves are not accurate. It is stated that it would be better, when designing the valve, to use approximate calculations giving the possibility of orientation among the various factors coming into consideration, rather than to leave all this to experimental practice. Based on certain given assumptions regarding valve-stem elongation, and the kinetic energy of the valve, which is divided according to the work done by particular parts of the valve, formulas are presented for calculating the absorption of energy of the various masses. The writer then derives formulas for finding the strains and displacements produced by the masses. A final formula gives the total displacement of the end of the valve stem. *Aircraft Engineering*, November, 1944, pages 320, 321, 2 illus.

Lightplane Engine Problems. Lt. Col. Ralph S. White. Some of the problems affecting light-plane engine development are reviewed. The discussion relates only to four-cylinder, horizontal opposed, air-cooled engines of types manufactured by Aircooled Motors Corporation, Aviation Manufacturing Corporation, and Continental Motors Corporation. Among the 17 types of problems investigated are those involving failures, idling, icing, education, replacement parts, fuel and oil, detonation, quality control, and overhaul. Others are classified under the headings of starting, personnel, vibration, noise, standardization, visibility, welding, and public demand. Several charts are shown recapitulating the number of power-plant failures, attributable to different causes, on airplanes equipped with the so-called "Little Three" engines for the years 1936–1940. *Flying*, January, 1945, page 72, 2 illus.

The Intercooling Problem in Airplane Design. Holley B. Dickinson. Current practice in the cooling of aircraft-engine charge air is described and analyzed. Problems connected with charge-air cooling are discussed from the viewpoint of the air-frame designer. Questions involved in the selection of the type and capacity of charge-air cooling installations, which are difficult to subject to quantitative analysis, include simplicity, mainte-

nance, accessibility, and arrangement of engine installation. It is stated that, in general, the difficulty of installation of the charge-air system is out of proportion to the core size. The weight increase attributed to the system, for instance, is in the neighborhood of five times the weight of the air-to-air intercooler core. It is also stated that the use of a liquid-to-air aftercooler system as opposed to an air-to-air intercooler system shows promise only in applications with liquid-cooled engines where the separation of the ultimate cooling unit from the rest of the installation is a definite arrangement advantage. *SAE Journal*, December, 1944, pages 557–653, 572 (Transactions), 5 illus.

Analysis of High-Frequency Ignition Circuits. A. W. Robinson, Jr. It is stated that because advances in aircraft-engine design are yielding higher power outputs at higher altitudes, certain limitations of the conventional high-voltage ignition system have become of great concern to the ignition engineer. Not only is it necessary to generate and distribute higher and higher voltages at extreme altitudes, where air becomes a poor insulator, but the higher energies at the spark plug contribute to accelerating the erosion of spark-plug electrodes and decrease their life. The advantages offered by low-voltage, high-frequency ignition systems that are being developed by several manufacturers are outlined. It is noted that most of these systems utilize the same basic high-frequency circuit: a capacitor, charged to a predetermined voltage considerably lower than the plug voltage, is suddenly discharged through the primary winding of an oscillation transformer, the secondary winding being connected to the spark-plug electrodes. This circuit is stated to be nothing more than the original Tesla circuit invented in 1890. The writer presents an analysis of the basic Tesla circuit to elucidate some of the fundamental concepts connected with it. The effect of primary lead inductance and resistance losses are examined. The conclusions reached are summarized. *Electrical Engineering*, December, 1944, pages 916–919 (Transactions), 6 illus.

The Problem of Future Development of Aircraft Propulsion. Boleslaw Szczeniowski. This is the first of a series of articles in which various types of aircraft propulsion are analyzed and compared. The performance requirements of military aircraft are outlined and consideration is given to means of increasing their efficiency with regard to range, load-carrying capacity, flying speed, and ceiling. It is noted that the range and speed of a plane depend on the engine qualities, unit weight being of primary importance for short-distance flights, and engine efficiency for long-distance flights. Means of improving propulsion units are considered. Sections of the article discuss the Diesel engine, an engine based on new lines, steam engines and turbines, rocket drive, utilization of the heat of combustion residues, and the improvement of fuels. *Polish Engineering Review*, October, 1944, pages 66–72, 5 illus.

The Relation of Intake-Charge Cooling to Engine Performance. E. A. Droegemueller, D. S. Hersey, and W. A. Kuhrt. The advantages of intake-charge cooling as a means of obtaining higher specific output and improved fuel economy from aircraft engines are set forth. An attempt is made to evaluate logically various accepted methods of reducing the intake-charge temperature. The need of intake-charge cooling for the suppression of detonation in highly supercharged engines is explained. Methods of reducing intake-charge temperature evaluated include those using intercoolers, aftercoolers, and secondary liquid injection. It is shown that the choice of any one of these methods depends largely on the type of engine installation and the use of the airplane. The relative advantages of these methods are summarized. *SAE Journal*, December, 1944, pages 614–620, 11 illus.

Flight Technique

Flying a Boat. Capt. David Brice. It is noted that when a flying boat is on the water it is virtually a marine vessel and therefore subject to natural and man-made laws of the sea. The operation of the flying boat under these conditions is discussed. Sections of the article refer to moorings, taxiing, take-off, landing, and mooring procedure after landing. *Aeronautics*, December, 1944, pages 47–50.

Fuels

High Octane Gas. W. L. Baker. Recent developments in the manufacture of aviation gasoline are discussed, with particular reference to increases in the potential power output and fuel economy of engines. The writer discusses the manufacture of high-octane gasoline with the aid of the "magic bead" catalyst developed by the Socony-Vacuum Oil Company, Inc.

It is noted that improvements in the antiknock quality of gasoline can be utilized in either of two ways—(a) by redesigning the engine to increase the power output through the use of higher supercharge pressures or (b) by increasing the compression ratio, which will result in better fuel economy at the same power outputs. It is estimated that improving fuel quality from 91 to 100-octane number has allowed an increase of approximately 25 per cent in the specific output of aircraft engines by permitting additional supercharging. On the other hand, a similar increase in fuel antiknock quality would allow an approximate 5 per cent reduction in fuel consumption through increases of compression ratio. Utilization of higher fuel quality during recent years has been directed primarily toward allowing increases in specific power output, al-

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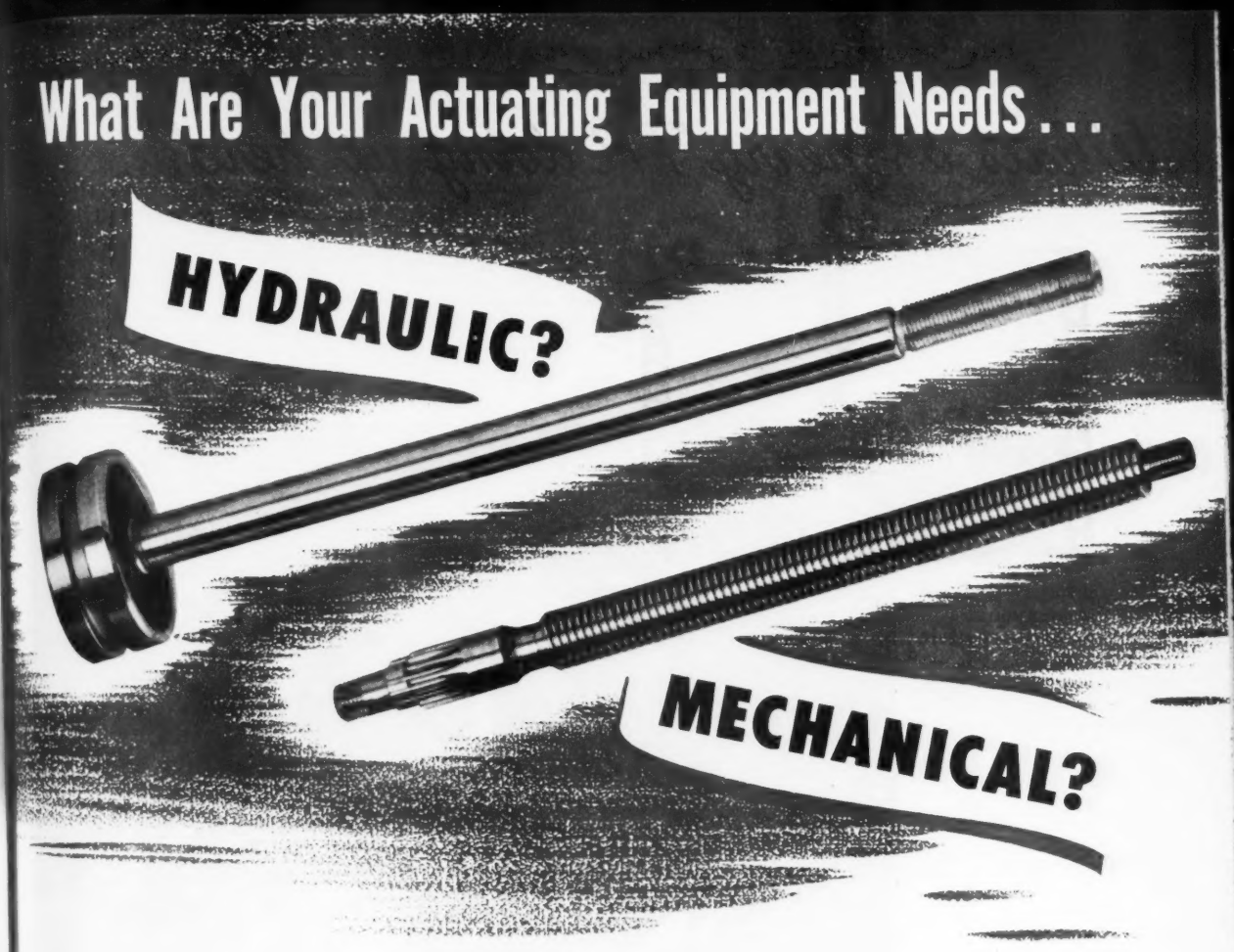

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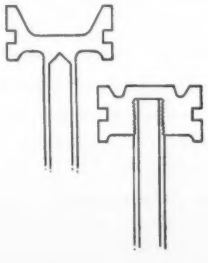

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though some improvements in fuel consumption have resulted from slightly higher compression ratios and the use of leaner carburetor settings. It is expected that, in the future, fuel economy during cruise will be a major consideration. As a result, it is anticipated that engines will employ higher compression ratios when fuels having antiknock quality considerably above 100-octane number are made available. *Aviation Maintenance*, December, 1944, pages 74, 188, 192, 1 illus.

Gliding and Soaring

Motogliders—A Natural Link Between Gliders and Light Planes. Wieslaw Z. Stepniewski. Several aspects of motoglider problems are considered. The official Federation Aéronautique Internationale (F.A.I.) definition of a motoglider is analyzed and compared with one based on the minimum sinking speed of a motoglider with its engine stopped. The influence on the speed polar diagram in power-off flight of such structural parameters as wing loading, aspect ratio, and minimum drag coefficient are considered. The possible limits for the performance of motogliders in powered flight are also examined. The power loading appears in these considerations as a new parameter in addition to the ones previously mentioned.

The following special problems are discussed: (1) means of reducing the drag of the propeller when the engine is stopped; (2) general design of the motogliders; and (3) the most suitable engines. Also presented are some aspects of general experience accumulated during 3-year tests with motogliders in Poland. In conclusion, the paper states that, in the case of a nation-wide program (based on gliding) for attracting air-minded youth to an active part in aviation, motogliders might play their role as a natural link between gliders and light planes. *Journal of the Aeronautical Sciences*, January, 1945, pages 39–46, 9 illus.

Tactical Uses of Gliders. Major Eliot F. Noyes. To provide a picture of the great development that has occurred in military glider operations in slightly more than 3 years, a comparison is made between the air-borne invasion of Crete in May, 1941, and that of Normandy in June, 1944. The characteristics of a glider that make it useful for military operations are outlined. It is noted that the glider is really a large container for delivering men and supplies, and that it can be retrieved full or empty. Various types of tactical operations for which gliders have been used or might be used are described. *Soaring*, July-August, 1944, pages 1–3, 12 illus.

Why Singleplace Glider Training Was Used in Europe. Jerzy Illaszewicz. It is noted that independent experiments made in Germany, Poland, and Russia during the period following the first World War pointed to the conclusion that single-place gliders were best for training purposes. It is stated that the reasons for this conclusion were threefold; technical, psychologic, and the fact that single-place instruction is a definite asset in building confidence and initiative. The writer discusses each of the three categories. *Soaring*, July-August, 1944, pages 4, 5, 1 illus.

Applying Jet-Propulsion to Gliders. Zbigniew Zrzywoblocki. Following an outline of the principles of rocket and jet propulsion, the writer discusses the advantages that gliding can gain from reaction propulsion. The conditions of flight to which reaction propulsion might be applied are listed as: (1) take-off from a level hilltop, no gain in altitude required; (2) take-off from flat ground, with a requirement that altitude must be gained; (3) horizontal flight. It is stated that the purpose of applying reaction propulsion in cases (1) and (2) would be to eliminate external take-off devices and to gain the altitude needed; in case (3) it would be used to pass from thermal to thermal. The relative merits of petroleum fuels and black powder are discussed, and the weights of the two types of propulsion equipment are compared. The results of the calculation of the size and weight of powder rockets and other data are given in tables, both for land gliders and sea gliders. A diagram of a uniflow jet-propulsion engine is shown and its specifications are listed. *Soaring*, July-August, 1944, pages 7–9.

Cumulus Sailplane. Stephen Smith. A description is given of the development of the "Cumulus" sailplane, the designing of which is stated to have taken months of the writer's spare time, and the actual construction 3 years. The result was a single-place, high-wing, plywood-and-fabric intermediate type of sailplane with a wing span of 46 ft. The fuselage is built around four spruce longerons and frames having flat sides, a vee bottom and semi-elliptical top. Mahogany plywood is used for covering. A single wheel with a 5.00 by 4.00 tire is attached to the main beam bulkhead, slightly ahead of the normal c.g. location. A steel-sheathed wood skid extends ahead of the wheel. The design and construction methods followed and the reasons for adopting them are discussed. Specifications listed include: span, 46 ft.; length, 20 ft. 6 in.; weight empty, 350 lbs.; wing area, 153.1 sq.ft.; best cruising speed, 42 m.p.h.; gliding ratio 21 to 1; airplane towing speed 70 m.p.h. *Soaring*, July-August, 1944, pages 10, 11, back cover, 3 illus.

Alpine Gliding in Switzerland. W. Dollfus. Concerned mainly with the development of motorless flying in mountainous regions, this article records how gliding in Switzerland has been improved and expanded during the war years. It is reported that in spite of certain indicated wartime restrictions, the number of glider pilots in training and their flight achievements during the year 1943 have surpassed prewar statistics. The article also contains reports on the Swiss Aero-Club's competitive meet held in 1943 and on the club's plans for postwar international competitions. *Aviation Review*, November, 1944, pages 12, 30, 3 illus.

History

The Flagship Fleet. Eric Harald. This extensive article on American Airlines is concerned not only with the history of the company, but also with its current civilian and military operations. American Airlines' organizational development is reviewed through its various stages from 1929 to the present time. Technical advances, operational procedures, service innovations, and training activities in which the company pioneered are recorded. Men who have helped direct its destinies are mentioned; airplanes that have been used are noted; and plans for the future are reported. *Skyways*, January, 1945, pages 22–24, 60, 62, 64, 92, 11 illus.

"It Started at Toronto." Frank H. Ellis. An account is given of an airplane flight stated to be the first advertised exhibition flight in an American-made machine to take place on the North American continent. This was made by Charles F. Willard in a plane called the "Golden Flyer" at Toronto, Canada, in September, 1909. A description of the plane is included in the step-by-step review of the exhibition flight. *Canadian Aviation*, December, 1944, pages 78, 79, 140, 3 illus.

Hydraulics

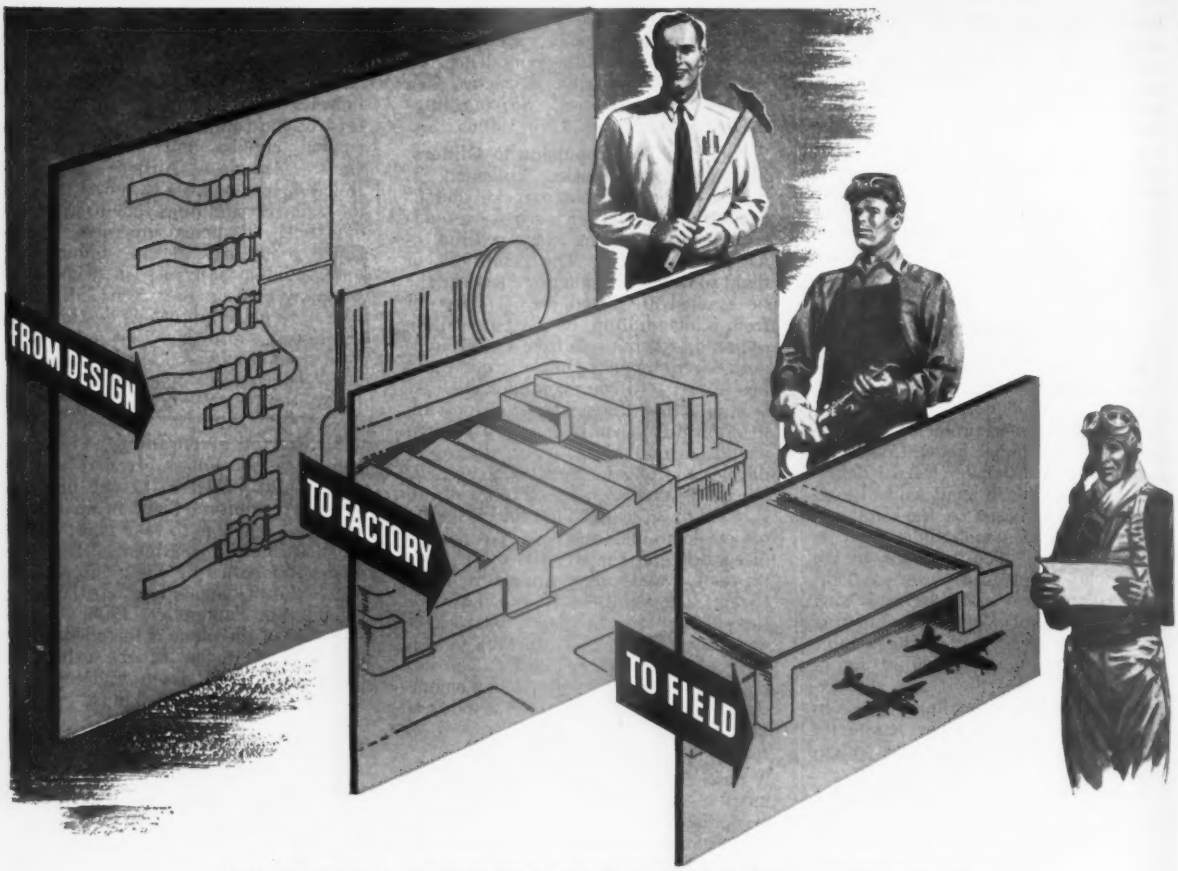
Designing Hydraulic Actuating Cylinders. Part I. James E. Thompson and Rodney B. Campbell. This first of a series of articles gives basic data for developing a practical design for a typical double-acting pin-joint cylinder that will be applicable to all forms of aircraft hydraulic actuating cylinders.

It is stated that a majority of the design modifications encountered will involve only the end connections and mounting provisions, the internal working parts remaining substantially unchanged. The limiting factors determining the principal specifications for the cylinder are outlined. Detailed suggestions are given for commencing the design and planning the form, dimensions, and materials for the cylinder and piston. Calculations for the fit of the O-rings and for the threads at each end of the cylinder barrel conclude the first section of the article. *Western Flying*, December, 1944, pages 78, 80, 82, 84, 6 illus.

Inspection

A.I.D. Inspection in Aluminum Foundries. E. Carrington. The practice followed by the Aeronautical Inspection Department of the British Air Ministry in the inspection of light-alloy castings is summarized. An outline is given of the system established for the development of official specifications.

Current light-alloy specifications are listed numerically and tabulated. *Light Metals*, December, 1944, pages 570–576.



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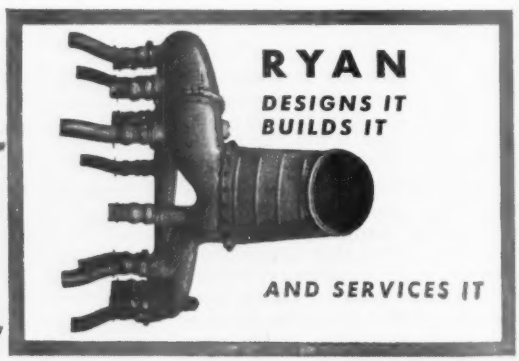

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Instruments

Lag Determination of Altimeter Systems. Richard M. Head. It is the purpose of this paper to consider the total lag of altimeter systems and to present curves that will permit a direct and simple determination of the correction term to be applied for the combined lag caused by the acoustical and mechanical parts of the altimeter system. The existing methods for correcting for this lag involve only the acoustical system, that of the instrument being considered negligible. This assumption undoubtedly holds for small rates of change of pressure; however, for high rates this quantity can no longer be neglected.

Furthermore, the variation of the characteristic time of the system with the magnitude of the applied step function is apparently not considered. This paper incorporates the instrument lag with that attributable to the line, since, with the increasingly faster rates of climb and diving speeds of present-day airplanes, this quantity can no longer be neglected. In addition, an attempt is made to arrive at a truer value of the characteristic time than that obtained by existing methods.

From the equations presented, a family of curves similar to those given in the paper may be developed for any altimeter system, once the constants of the system have been determined by the simple experimental method outlined. Such a family of curves will enable the easy and accurate determination of the lag at any instant in a climb or dive for a given airplane. A knowledge of the true altitude will result in a more accurate knowledge of true speed, Mach Number, etc., with the resulting increased accuracy in flight-test data. *Journal of the Aeronautical Sciences*, January, 1945, pages 85–93, 13 illus.

Maintenance

Corrosion. Parts III and IV. Ray Sanders. Part III of a continued article in which corrosion prevention, cleaning, and other problems connected with aircraft maintenance are discussed describes the cleaning procedure for aircraft-engine overhaul. Immersion cleaning is discussed and information is given about the carboblast method by which stubborn carbon accumulations are removed through buffing with ligno-cellulose pellets in a blast of air. Specialized cleaning compounds and equipment for certain difficult operations are discussed.

Part IV is devoted to the surface maintenance of aircraft. The writer discusses the effective application of paint to metal and the removal of old paint during overhaul and reprocessing. *Air Tech*, December, 1944, pages 34–36, 8 illus.; January, 1945, pages 33–35, 62, 7 illus.

Prospectus for Postwar Service. Reagan C. Stunkel. The functions and setup of a manufacturer's service organization for postwar operations are described. A chart illustrates the organization plan, and reasons are given for the development of the plan by analyses of the functions of the departments shown on the chart. As suggested, the manufacturer's service organization, encompassing both military and commercial types of service, would include the following divisions under the direction of an Office of Service and the Vice-President in Charge of Sales and Service: service engineering, service shops, field operations, administration, authorized repair stations, aircraft tools and equipment, and service training.

A basis of comparison is provided for the postwar plan by an outline of Lockheed Aircraft Corporation's present-day service organization and its operations. It is noted that, in addition to normal service functions, Lockheed's service organization is charged with additional responsibilities of tool and equipment design, modification, and engineering for aircraft on which production schedules have been completed. *Aviation*, December, 1944, pages 132–134, 288, 289, 3 illus.

MacDonald Bros. Provide Float Maintenance of Highest Standard. Based on the methods employed by MacDonald Bros. Aircraft Ltd., this is a survey of the operations and equipment by which aircraft floats are overhauled and kept at their maximum efficiency. Details of float design and construction help to explain some of the maintenance procedures. The information given pertains to causes of and protection against corrosion, prevention of barnacle growths, application of Alclad in the maintenance procedures, heat-treatment practices, skin examination routines, reassembly methods, repair work on floats damaged by collision, and overhaul processes peculiar to individual parts of the float. *Canadian Aviation*, December, 1944, pages 163, 164, 166, 168, 15 illus.

Service Snafu Nipped in the Bud. This article deals with the monthly service and maintenance publication put out by the Douglas Aircraft Company, Inc. It tells how *Douglas Service* is written, to whom it is distributed, and the purpose that it serves in helping to keep more combat and transport planes at their maximum efficiency. The evolution of a story in this magazine is traced through stages of investigation, writing, illustration, checking of mechanical details, and editing, from the origination of the idea until the material is ready for publication.

As related, the magazine is divided into sections corresponding to the Douglas models in current use. Within these sections are developed proper lubrication methods, trouble shooting, procedures for all systems, concise and complete service instructions, new maintenance short cuts, advance information about new installations, and practical field reworks. Articles are illustrated by photographs, cutaways, schematic diagrams, and charts. *Aviation*, December, 1944, pages 149–151, 297, 4 illus.

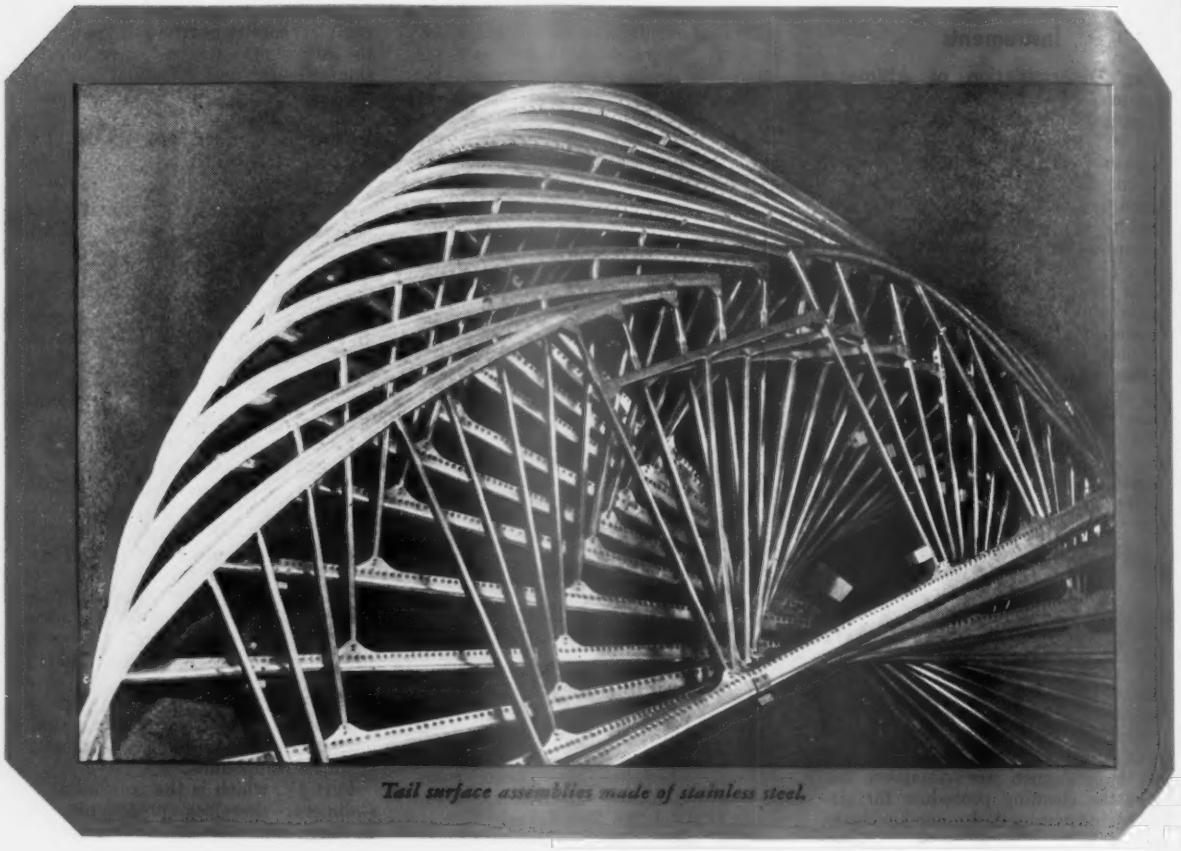
Winterization of Light and Medium Weight Flight Equipment. Frank P. Davis and Ed W. Hudlow. Part one of a two-part article furnishing information to private owners, pilots, and mechanics regarding the winterization of aircraft equipment. The first section of this installment is devoted to engines, accessories, and controls used in light and medium-weight aircraft. The second section deals with aircraft accessories, instruments, and controls in the medium and lightweight classification. *Aviation Maintenance*, December, 1944, pages 52, 53, 222, 224, 228, 230, 232, 234, 236, 238.

Aircraft Cleaning. Parts III and IV. Gilbert K. Brower. Part III of this article on the cleaning of aircraft further discusses the equipment-requirements phase and summarizes procedures currently being followed by Army, Navy, and air-transport operators at base repair shops and as recommended by aircraft and aircraft-engine manufacturers of industrial chemical compounds.

Part IV, which is the concluding installment, describes procedures particularly applicable to line maintenance and general cleaning. Sections are devoted to the cleaning of aircraft exteriors and interiors including rugs, etc., disassembled components of aircraft, oil coolers, radiators, and spark plugs. *Air Transport*, November, 1944, pages 124, 127, 129–131, 2 illus.; December, 1944, pages 74, 76, 77.

TWA Gets Double Benefits From Shop-Built Mockups. Information is given about the series of cutaway demonstration units that have been built by every department in the Transcontinental & Western Air, Inc., Kansas City maintenance base. Originally devised to acquaint visitors with the type of work being done in each department these mock-ups are employed as training aids for apprentices, service mechanics, and other personnel throughout the company. They are also reported to have been the means for boosting morale in the different departments. Although many of the exhibits were created from scrap materials, transparency is obtained through the use of plastics. Photographs of various units are shown. *Aviation*, December, 1944, pages 141–143, 8 illus.; "TWA Shows the Works," *Air Transport*, December, 1944, pages 59, 60, 65, 66, 8 illus.

Corrosion in Aircraft Gas Tanks. An outline is given of the method used by Northwest Airlines, Inc., for repairing corroded gasoline tanks. The operation involves replacing the bottom of the tank where corrosion takes place. Consecutive steps in the procedure are described. *Aviation Service Magazine*, November-December, 1944, pages 24–26, 5 illus.



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The extremely high strength-to-weight ratio of Republic ENDURO Stainless Steel is of particular value to aircraft designers and engineers in achieving light weight and greater strength.

Because of this important property of ENDURO, it is possible to use smaller, lighter sections in structural assemblies without sacrifice of strength or safety.

ENDURO does not rust or corrode—requires no extra thickness to offset weakening and loss of metal due to corrosion—requires no protective coating.

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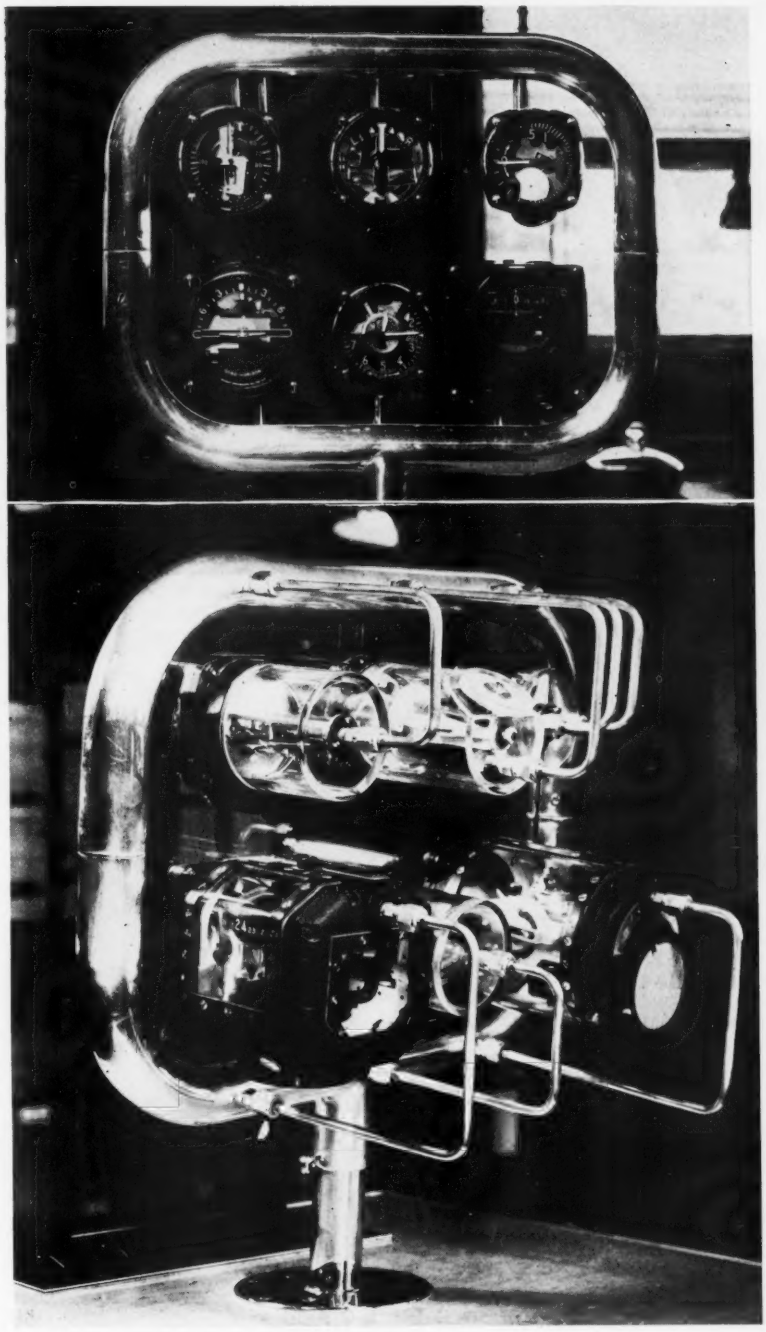
How to Maintain Aircraft Fabric. Advice is given on the proper maintenance of aircraft fabric and the care and cleaning of finishes. Accompanying the article are charts illustrating fabric-maintenance procedures and techniques. *Aviation Maintenance*, December, 1944, pages 86–98, 10 illus.

Standardized Maintenance Means More Fixed-Base Business. C. C. Mosely. The President of Grand Central Airport Company, Cal-Aero Technical Institute, and Mira Loma Flight Academy, tells how standardized maintenance procedures, developed by A.A.F. flight-training contractors during the war, will be applied to peacetime operations. He also explains how the reduced costs and improved results of production-line maintenance will germinate more business for the fixed-base operator. It is his belief that standardized charges will probably follow standardized methods.

As indicated by the writer, one of the basic features of production-line maintenance is the shifting of the work from general mechanics to specialists operating in crews. Advantages derived from this system are emphasized by comparisons of the time it takes for specialist crews to overhaul a plane with the time it took for general mechanics to do so. Consideration is also given to the value of cooperation between operators, as shown by the Aeronautical Training Society which is composed of the 64 schools contracted for A.A.F. primary training. *Aviation*, December, 1944, pages 136, 137, 284, 287, 4 illus.

Fabric Service. Ed Packer. An account is given of the procedure for handling repairs to aircraft fabric, which is based on practical experience and is stated to conform to Civil Aeronautics Administration regulations. Supplies required for the work are listed. The writer discusses "dope" and its application, rib-stitching methods and techniques. Information is given about the length of the needles required, the length of the stitches for different types of planes, the waxing of thread, and fabric-strength requirements. *Aviation Service Magazine*, November-December, 1944, pages 16–22, 54, 55, 14 illus.

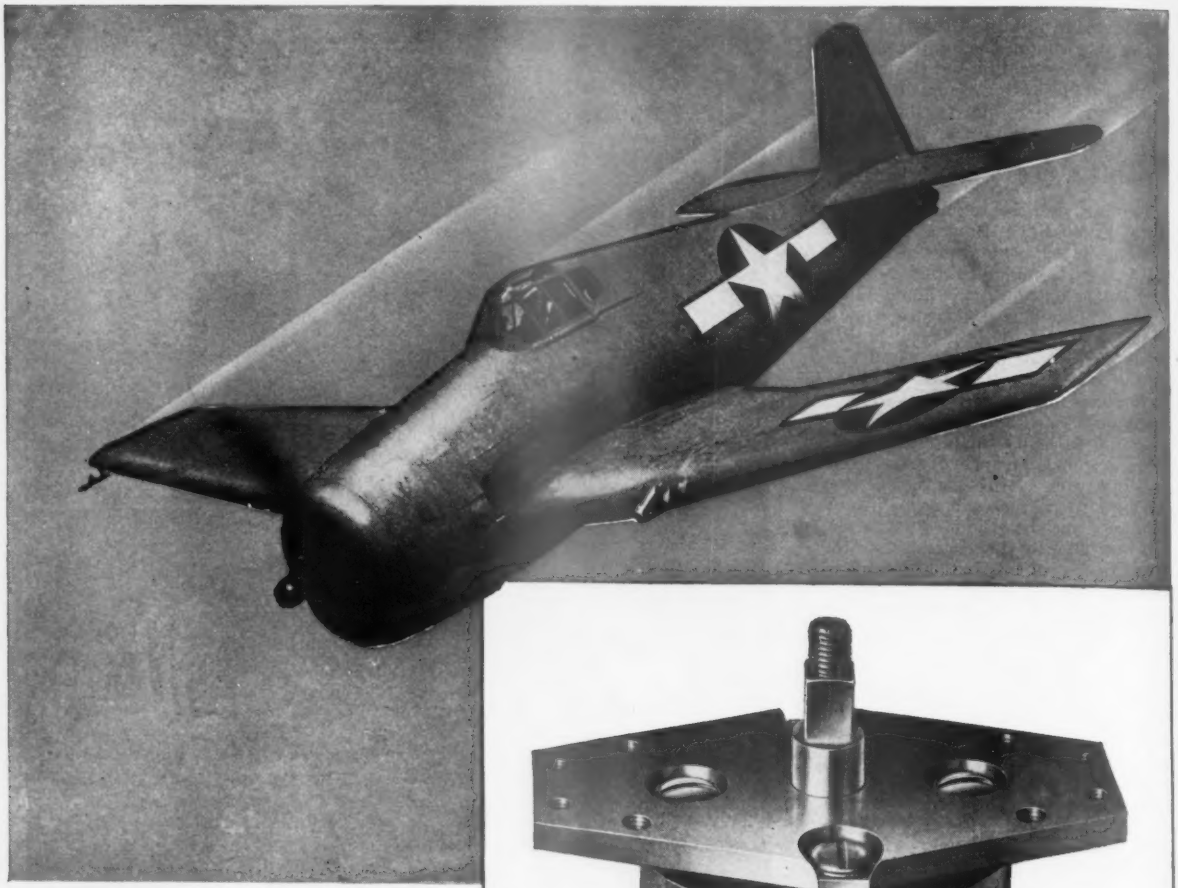
More Seats Up . . . More Costs Down. This is an article on the layout of the upholstery shop at the Cheyenne repair depot of United Air Lines. It shows how maintenance costs were reduced, loss of motion and time eliminated, and more complete use made of existing machinery by the scientific location of work stations for reupholstering old aircraft seats and finishing new ones. Details are illustrated by a diagram of the shop's layout, which also shows how the work is routed. The planning provides that, from the time the raw stock is classified until the finished work is gathered, the total distance traveled is only slightly more than the length of the shop. *Aviation*, December, 1944, pages 135, 288, 1 illus.

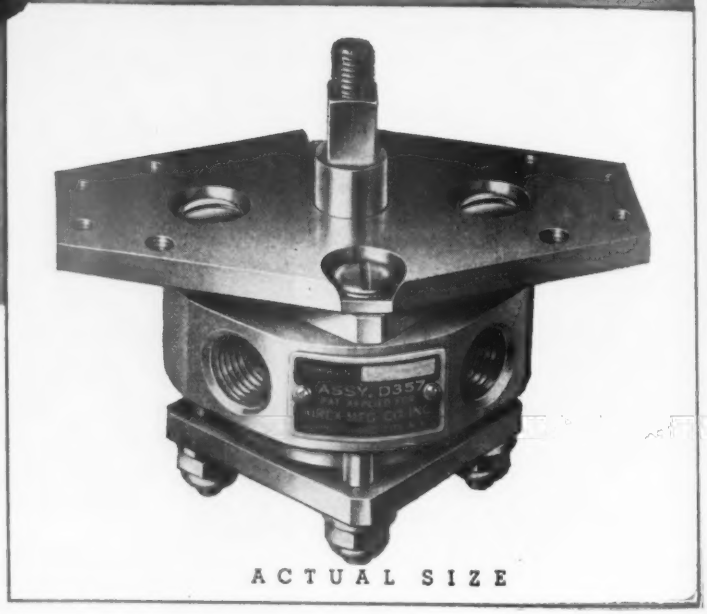


An exhibit in the TWA shops built by mechanics at the air-line's main base in Kansas City. The top view shows primary flight instruments mounted in a Lucite panel supported by an aluminum frame and containing pressure and suction lines to operate the instruments. The panel can be offset and oscillated to simulate movement of the plane about three axes.

Management

Production Performance Comparison. P. B. Crouse. In the presentation of an extension of the principle of T. P. Wright's "80 Per Cent Curve," the writer offers a method for measuring the efficiency of airplane-manufacturing operations. After outlining the variables that affect existing plans for determining production efficiency and manufacturing costs, he explains a method developed from the formula for the 80 per cent curve in which allowance is made for such variables, particularly the "learning factor," which reflects the efficiency gains resulting from cumulative experience in building





ACTUAL SIZE

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USED
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BUY MORE WAR BONDS

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Aircraft research & development—Hydraulic equipment

large numbers of airplanes. It provides for the measurement of production in weighted units that compensate for the effect of the curve and are called "weighted airframe pounds" or WAP, upon which is based a factor representing the ratio of the normal unit cost of the 1,000th airplane of a given model, expressed as "WAP per lb. of airframe." A table of these factors, adjusted for each airplane from the first to the 20,000th, is reproduced, and the use of the formula and the tables is explained with the aid of examples.

Other tables and charts show the comparison of the "hours per pound of airframe" method with the "hours per WAP" method for cases in which two companies are producing the same model of airplane, and two contracts at different cumulative production points. Similar figures are given for two companies producing different types of planes.

One of the examples shows that although the hours per pound figure for a certain operation dropped from 5.15 to 3.87 during a period of 10 months, indicating satisfactory improvement, the actual cost per WAP rose from 1.96 to 2.70 hours, showing an increase of 38 per cent in labor cost and a corresponding drop of 27 per cent efficiency or performance. Following additional comments about the correct interpretation of the figures derived by the formulas, an adjustment factor is introduced for comparing the performance of plants working on different types of products and its application is discussed. The advantages of the plan are summarized. *Aero Digest*, December 1, 1944, pages 68-71, 119, 120, 123, 3 illus.

Streamlined Machine Shop Control. T. E. Mechem. The system employed by the Douglas Aircraft Company's machine shop for planning and paper work is detailed. With this system, it is reported, paper work has been reduced to one form which travels with the parts. This form contains the blueprint sketch, process of manufacture, setup information, tools necessary, feeds and speeds, and current contract data. As related, the procedures organized in the plant are as follows: (1) The engineering department releases the blueprint and job ticket to the tooling division. (2) The tooling department makes a preliminary manufacturing outline for departmental requirements. (3) The outline is sent to a committee representing the machine shop, time standards, and machine-shop parts control, for analysis and developing the best method of fabrication. (4) After approval, the detailed operational planning is done by the time standards group and definite machine assignments are established by the machine-shop representative. (5) This information is returned to the tooling division for a master Ditto set on each operation and a sketch is drafted on the lower half of each operation sheet. (6) The master Ditto set for each operation is forwarded to the machine-shop parts control for filing at the incoming dock, awaiting the arrival of the current shop

orders, with the due date, like-part numbers, etc. An applique is applied containing any vital information for time-keeping changes. This applique is used on each operation sheet for the part number, eliminating any further hand transcribing.

Other paper work consists of a Kardex job card, status sheet, and a tooling-withdrawal slip. The operational sheet is run on the reverse side of the status sheet. At the same time the master applique set is typed, a master traveler, providing space for all inspection "buys," is attached to the part. This also provides a permanent identification. Six advantages are claimed for the discussed "paper work" system. They are: (1) Production Supply saved hundreds of hours in the direct handling of parts—time that had been used in chasing blueprints, manufacturing outlines, and project sketches; 50,000 hand transcriptions per month; approximately 6,500 calculations on the comptometer per month. (2) Machining parts on obsolete blueprints were eliminated. (3) Time was saved in refiling process sheets after each operational run. (4) Time dispatching was cut to a minimum. (5) Machine-shop operational inspection eliminated running spoiled parts on subsequent operations. (6) Past-due orders were controlled to a minimum. *Aero Digest*, December 1, 1944, pages 94, 96, 6 illus.

Marketing

Embry-Riddle's "Trade-In" System. Ted W. Nelson. Indicating the value and workability of "trade-in" policies for personal aircraft, this article describes some of the features of the trade-in system sponsored by the Embry-Riddle Company, at its Miami aircraft and engine division. It is related how the trade-in plan is applied to light aircraft and engines, as well as to propellers, instruments, and accessories. With the greatest volume of business anticipated in the light plane, the policy is reportedly limited to engines and accessories in planes under the $5,000 class.

Advantages and present obstacles to the plan are noted. In citing the advantages, the writer marks the elimination of the time-lapse that is necessary when a plane or component is repaired as the paramount advantage to the operator.

The article also explains how the trade-in business is a natural supplement to the repair and maintenance business of an overhaul base. It stresses the importance of efficient repair work and maximum service as well as the desirability of having the overhaul division located at an airport. In addition, information is given about some of the special tools and fixtures that have been designed by the Embry-Riddle Company for their maintenance services. *Aero Digest*, December, 15, 1944, pages 96, 97, 226, 3 illus.

Here's Your Local Market. Frank S. Christian. Aircraft dealers and distributors are advised how to analyze the potential sales volume contained in any specific territory. They are also given merchandising suggestions for exploiting that market area once it has been established. The answers to four major problems confronting the prospective distributors or dealers are discussed at length. These problems are: (1) what plane or planes should he sell; (2) how to determine the number of prospective purchasers in his territory and where they are located; (3) how much of an organization he needs to serve his territory adequately and make a satisfactory profit; (4) how large a showroom is necessary and whether it should be located at the airport or downtown.

A sales-solicitation program—encompassing contacts by mail, phone, and personal calls—is outlined. This outline includes information about where to obtain prospects as well as how to follow them up. The article is supplemented by a table showing how to establish a sales operating budget. *Aviation*, December, 1944, pages 122–124, 277–279.

Aircraft Sales Engineering. John C. Creigier, Jr. A comprehensive discussion of the purpose and importance of sales engineering in airplane distribution. Demonstrating that the expansion of postwar aircraft markets depends upon more economical distribution and, in the case of the personal airplane, making the airplane easier and more "foolproof" to fly, as well as more economical to own and operate, the writer indicates how efficient sales engineering can help to achieve these goals. Sales engineering is interpreted as the science of creating and satisfying a demand for technical products and services that require engineering ability in their choice and application. The duties of a sales engineer, the training with which he should be equipped, and the manner in which his work should be carried out are specified. Separate consideration is given to his function in the personal-airplane, military-airplane, and air-transport fields. While comparisons in desirable sales-promotion techniques are made with automobile-merchandising practices, the writer calls attention to the fact that airplane sales will probably be limited to a relatively small, highly concentrated market requiring the more specialized knowledge of salesmen who also have engineering or technical backgrounds.

The article also outlines a typical functional aircraft sales setup. A chart illustrates the organizational plan and

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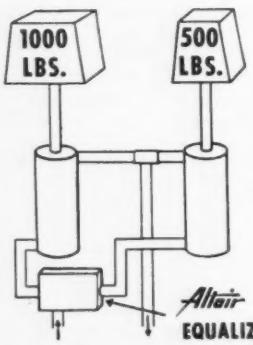
Revolutionary development meters fluid in either direction



Irrespective of wide differentials in loads or rate of flow the Altair Equalizer synchronizes the action in *both* directions. Although the cylinder on the left is doing twice the work of the other – both cylinders travel at the same speed during their entire strokes.

Here – for the first time – hydraulic fluid is accurately metered in either direction from one line into two branch lines. Differentials in restriction, loads or friction are compensated for, even in pronounced unbalanced conditions.

The installation is unique. It is only necessary to install the Altair Flow Equalizer in place of the "T" in the pressure *or* return line to accomplish full synchronization of the hydraulic actuating cylinders or motors.

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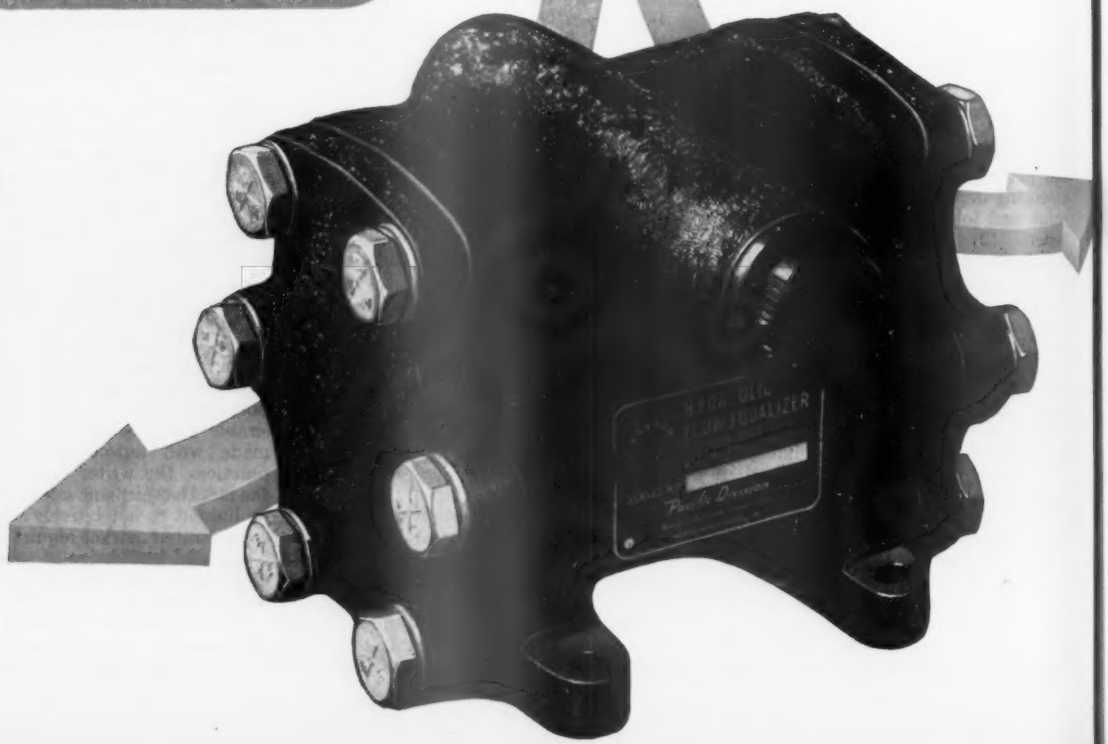

lists the functions of the various divisions as they are discussed in the article. The divisions are the service, contract, selling, administrative, public relations, and export divisions. *Aero Digest*, December, 15, 1944, pages 79–81, 136, 138, 2 illus.

Materials

New Aluminum Casting Alloys—Strong as Cast. Hiram Brown. The various types of "strong-as-cast" aluminum alloys that require no high-temperature treatment are described. The terms are defined and information is given regarding the engineering properties of the alloys. Present and potential fields of application are indicated and specifications are tabulated. *Metals and Alloys*, December, 1944, pages 1616–1619, 4 illus.

18-8 Stainless Modified for Formability. Wilson G. Hubbell. The writer describes tests conducted by the Ryan Aeronautical Company for the purpose of determining the most desirable formula for a suitable stainless-steel stock for aircraft parts subjected to high temperatures, particularly exhaust manifolds. In addition to high resistance to corrosion, the requirements were for a steel that would lend itself to the forming of aircraft parts and to the processes of gas, arc, and resistance welding.

Details of the tests are given, with descriptions of the composition of the samples, the effects of different alloying elements, and the welding characteristics. The tests revealed that type No. 347 columbium-stabilized stainless steel has the required ductility, creep strength, and good welding properties. *The Iron Age*, December 7, 1944, pages 78–82, 8 illus.

Modern Impregnating of Magnesium Castings. Harold A. Knight. A number of impregnating agents and treatments used to plug up the pores of magnesium-alloy castings to make them pressure-tight are compared. A detailed description is given of the applications and service performance of one synthetic product recently developed for this purpose. The characteristics of the impregnating compounds are discussed. Tests on magnesium and other materials are described. *Metals and Alloys*, December, 1944, pages 1625–1630, 6 illus.

Medicine

The Sky Is Not the Limit. Eric Sloane. It is explained that even with oxygen supply there is a limit to the altitude a human being can withstand. A chart shows the effect of altitude with and without an oxygen mask. It is pointed out that the human lungs depend on pressure to "squeeze" oxygen out of the air, push it into the alveoli, and finally into the blood stream. The squeezing force of air pressure at sea level is 15 lbs. per sq.in., about 14 tons on the average skin surface. Although air has the same percentage oxygen content at all altitudes, pressure is too greatly reduced at 30,000 ft. to squeeze out the oxygen adequate for human needs. *Air Tech*, January, 1945, pages 30, 31, 1 illus.

Experimental Production of Motion Sickness. E. A. Spiegel, M. J. Oppenheimer, G. C. Henny, and H. T. Wycis. The relative effects of various types of combined movements upon the human body, as induced by a specially constructed apparatus, are reported. The motion sickness discussed embraces syndromes of airsickness as well as seasickness, carsickness, etc. Details are given on the construction of the rotating-tilting machine that produced symptoms of motion sickness within 8 min. in 75 per cent of unselected subjects.

The article covers a comparison of results on the apparatus with previous experiences of the subjects. It is claimed that the weaker method of stimulation (rotation combined with sagittal movements of the head or body) was sufficient to reveal a high degree of susceptibility. The stronger stimulation (rotation combined with frontal head movements preceding or succeeding rotation combined with sagittal head movements) was effective in nearly all moderately susceptible persons and produced symptoms even in some persons who were supposedly not susceptible according to previous experiences.

It is stated that optic fixation of an object which participates in all movements of the head tends to diminish the incidence of motion sickness compared with the effect of stationary objects of the surroundings watched by the subject. A tentative explanation for the absence of nystagmus in seasickness is offered. In the experiments, typical illusions of spatial orientation were produced. Their appearance was independent of that of the vegetative symptoms of motion sickness, indicating that one deals with two rather independent mechanisms.

The conclusion is that symptoms of motion sickness may be elicited not only by stimulation of the maculas but by stimuli acting on the cristae ampullares. *War Medicine*, November, 1944, pages 283–290, 4 illus.

Military Aviation

Hungarian Air Force. A brief résumé of the history, organization, and equipment of the Hungarian Air Force, supplemented by a tabulation of its aircraft. The table lists the name of the airplane, the country of its origin, type, engines, span, length, and maximum speed. Also included are remarks regarding the number in service, whether the model is now obsolescent, and when it was supplied to the Hungarian Air Force. *The Aeroplane*, November 3, 1944, page 500, 8 illus.

Bomber Support. John Yoxall. Recent improvements in the combat techniques of British bomber-support groups are reviewed. The reported reduction in British bomber losses is credited to an important new device of the Bomber Support Group. This is the fogging of the enemy system of defense signals and the shooting-down of enemy night fighters before they are able to attack British heavy bombers. In carrying out these tactics, the principle is that the attack must be made before, not after, the target is reached. The article explains how the Mosquito planes of Bomber Support Groups foil the efforts of German fighters to get into the streams of British bombers and attack them there. *Flight*, November 16, 1944, pages 522–524, 4 illus.

An exploded view of a Superfortress, taken in Boeing Airplane Company's Wichita Division plants, illustrates graphically the Boeing multiline system of production. Major units of the giant bombers are brought together in the final assembly stages, each precompleted, including installation of electrical apparatus, wiring, tubing, instruments, upholstery, etc., and much of the flying and fighting equipment.

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P-51 Mustang pilots now fly under a protective canopy of transparent Du Pont "Lucite" methyl methacrylate resin. Because of its ability to be heated and formed into streamlined contours, this one-piece enclosure can be shaped by a new vacuum method in less time than was formerly required to produce the old-style canopy. This technique also reduces optical distortion during forming. In addition, the plastic "teardrop" reduces riveting operations and operations on alloy sheet stock as well as eliminating the use of machined parts.

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DU PONT PLASTICS

Paints and Coatings

New Wax Spray Method. Fred Page. Results of experiments with the spray-gun method of applying a protective film of wax to the outer surfaces of transport planes, as conducted by United Air Lines, are described. It is stated that the tests showed a saving of 80 per cent in the time required for an effective waxing job, and that the wax coating retained the plane's original luster for months. *Air Transport*, December, 1944, page 73, 1 illus.

Personalities

For Greatest Achievement. William Kroger. The history of the origin of the Robert J. Collier Trophy is given, with a review of the earlier awards that have been made of that trophy. Brief sketches of past winners and names of some of the members of the committee that has decided upon the awards are given.

The current award to Capt. Luis de Florez, Director of the Special Devices Division of the Navy Bureau of Aeronautics, is described, with a biographic study and a review of the achievements for which the award was made. *National Aeronautics*, December, 1944, pages 16–18, 26, 7 illus.; "He Won the Collier Trophy," by Frederick R. Neely, *Collier's*, December 23, 1944, pages 24, 42, 5 illus.

From Grease Monkey to Air Chief. "Speed" Wallace. Gen. Roberto Fierro, Chief of Mexico's Army Air Department, is the subject of this article. Events in the General's aeronautical career, the role he has played in furthering the course of aviation in Mexico, and his manufacture of the Teziutlan training plane are recorded. General Fierro's views with regard to the postwar potentialities of aviation in Mexico, the type of plane that will be needed by Mexico after the war, and the particular adaptability of the helicopter for Mexico are also reported. *Air Pilot and Technician*, December, 1944, pages 16, 17, 20, 4 illus.

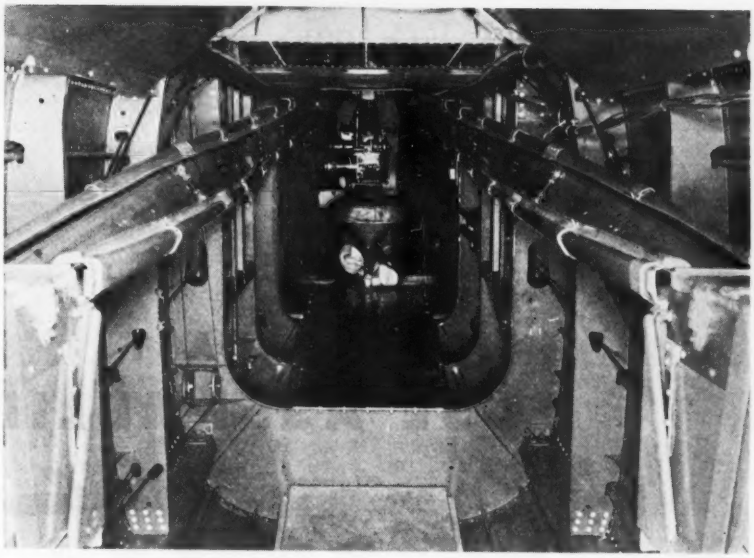
Personnel

The Navigator—A Post-War Misfit? Charles D. Mattingly. From a recent survey the opinions of leaders in the air transportation industry are quoted regarding the necessity and importance of the navigator's job on postwar air lines. Although some dissenting opinions are reported, the majority indicate that there will be a navigator's job, as such, in postwar air operations; that developments in radio, radar, and other mechanical aids will not lessen its importance; that the navigator's functions will not be reduced to duties performed by other crew members; and that the services rendered by the navigator will more than compensate for carrying the weight of a navigator and his personal effects.

The article supports the belief that postwar commercial aerial navigators will be required to be certificated. Present license requirements for British air navigators are outlined. An appraisal is made of postwar commercial opportunities for military navigators. *Flying*, January, 1945, pages 43, 101, 102, 104, 106.

Your Postwar Aviation Job (Air Pick-up). Major H. R. Bazley. Fourth of a series of articles investigating the possibilities of careers in the air-transportation field after the war. With its analysis based on the personnel employed by All American Aviation, Inc., this article tells of job potentialities in air pickup operations. Employment opportunities are considered as offered by three types of operations incorporating the use of pickup: air-mail and air-express operations; combination passenger and pickup operations; and glider pickup operations. Requirements for and the duties of pilots, flight mechanics, dispatchers, station messengers, and radio operators are described. A table lists the current salaries paid for these jobs as well as those of maintenance mechanics of all classes, and also indicates the probable number of personnel that will be required after the war in each of the air pickup jobs. *Flying Aces*, January, 1945, pages 22, 23, 57, 58, 5 illus.

Reconverting the Aircraft Worker. Frances Perkins. The U.S. Secretary of Labor examines the potential peacetime ability of the aircraft industry to absorb its wartime personnel and discusses some of the employment problems that may be expected during the reconversion period. She analyzes political, economic, and social variables that will affect the amount of postwar aircraft production. Reported figures on the tremendous employment expansion in the aircraft industry during war years help to indicate some of the contractions that will necessarily take place after the war. Cognizance is taken of the fact that the problems will be more pressing in certain areas in the United States than in others. However, it is the writer's opinion that "the overall picture is sound." *Flying*, January, 1945, pages 39, 120, 122, 1 illus.



An application of the use of plastics in aircraft construction is shown in the above photograph of two 8-ft. ammunition chutes and hoppers in the interior of the North American B-25 bomber. The use of plastic parts has enabled the designers to effect a weight-saving of 105 lbs. in each bomber.

Photography

Fundamentals of Photogrammetric Engineering. Part II. Reynold E. Ask. This is the second and concluding part of an article dealing with aerial photogrammetry. The writer discusses topographic and military mapping. A description is given of the various types of plotting equipment and methods used for topographic mapping, including the stereocomparagraph, the KEK plotter, the Brock process, and the multiplex equipment. The section on military mapping describes the Tri-Metrogon method, the continuous-strip camera, and night photography. The article concludes with the statement that for medium and small-scale mapping aerial photogrammetry has advantages over usual ground methods in economy, speed, completeness of detail, freedom from large errors, and permanency of record. Comments are made about the prospects for extending the scope of the science. *Engineering News-Record*, December 14, 1944, pages 84–89, 7 illus.

Plastics and Plywood

Plastics in Aircraft. Harry Carlson. Current airplane applications of plastic materials are listed. This list indicates what components and accessories of the aircraft are made of acrylics, cellulose acetates, phenolics, laminated phenolics,

AIRCRAFT
HOSE ASSEMBLIES
must:

1. Remain pressure-tight under severe vibration and flexing.
2. Resist the action of oil and gasoline both inside and out.
3. Withstand temperature ranges specified by the Air Corps.
4. Resist the action of cleaning fluid externally.
5. Withstand the abrasion of flying pebbles and sand.
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polystyrenes, ureas, vinyl-chloride acetate and vinyl chloride, and vinylidene chloride. Aircraft uses of plastic adhesives and finishes are also surveyed. *Flying*, January, 1945, pages 51, 52, 136, 138, 3 illus.

A Pressure-Tight, Blind Grommet. The construction of a two-piece, self-locking plastic grommet that can be applied by one person from one side of a partition is described. It is explained that where a "pressure-tight" model is required a flexible ring is slipped over the outside of the grommet after its installation. It is stated that this model is particularly suited for aircraft controls and cables that must be protected against chafing. Tests of the device are described, and applications in fields other than the aircraft industry are suggested. *Modern Plastics*, December, 1944, pages 106, 107, 200, 6 illus.

Postwar Aviation

Skyways South. The postwar plans of the Inter-American Escadrille are outlined and the history of its development is reviewed. Plans whereby the civilian flier, as a member of the National Aeronautic Association, which is now the United States Wing of the Inter-American Escadrille, may participate in inter-American aviation activities are described. *National Aeronautics*, November, 1944, pages 15, 16, 48, 1 illus.

Aviation's Expanding Opportunities for Individual Enterprise. Arthur W. D. Harris. An account of the peacetime plans of Southeastern Air Service, Inc., which is establishing a network of strategically located aircraft sales, service, and maintenance bases throughout the southeastern states. It is explained that the "associate base plan" is a cooperative arrangement under which Southeastern Air Service, Inc., extends an opportunity to local independent operators to conduct their individual operations in affiliation with the company. Franchises are granted to qualified operators on a territorial basis, with each owning his own business but operating it under the name "Southeastern Air Service, Inc., Associate Base." Details of the plan are outlined and the qualifications required for an associate-base franchise are listed. A chart shows dealer opportunities throughout the southeastern area. *Aviation Maintenance*, December, 1944, pages 39–43, 14 illus.

Private Flying

Easy Does It. Paul V. McNamara. A consideration of the complicated routine of examinations, records, certifications, and inspections that are required for the lawful operation of a personal airplane. Describing the various Federal and state tests and certifications that a person must undergo in order to buy, own, and operate a private plane, the writer stresses the need for eliminating some of the red tape regulations and revising others. *Air Facts*, January, 1945, pages 52–58.

Private Flying's Plight. John E. Geisse. It is the writer's opinion that obstacles have been placed in the way of popularized private flying by the design approach of manufacturers, by the lack of adequate airport service, and by superfluous governmental regulations. In urging revised design objectives for postwar private planes, he claims that in the interests of speed producers of prewar personal aircraft ignored the consumer's requirements for utility, quietness, safety, good visibility, and ease of operation. He also mentions several early developments in aeronautical design which would have contributed toward fulfilling these characteristics had they not been neglected until recently. On the subject of governmental regulations, he cites specific rules that can or should be eliminated. *National Aeronautics*, December, 1944, pages 13, 14, 26, 1 illus.

Alaskan Junket. John F. Rudy. This article discusses vacation touring in Alaska by personal plane. The advantages and disadvantages of an aerial tour of Alaska are outlined. Information is given regarding Alaska's airway facilities. The prospective visitor is advised to consult Civil Aeronautics Administration officials regarding the equipment needed for such a tour. *Air Trails*, January, 1945, pages 24, 25, 72, 76, 78, 2 illus.

The USE Program. Robert H. Hinckley. Demonstrating the national need for and the advantages of such a course, the Director of the Office of Contract Settlement outlines a program for making personal flying useful, safe, and easy. The program that he discusses embraces four prime requisites: mass aviation education, adequate landing areas, wise regulations, and research. The research factor is interpreted as pertaining both to pilot research and technical research. *Flying*, January, 1945, pages 76, 124, 126, 1 illus.

Production

Spar Production. Wilfred E. Goff. Concluding portion of a two-part article describing the techniques developed by Armstrong Whitworth Aircraft Ltd. for the production of Avro Lancaster spars. This installment deals with the milling of the center-section spar booms. It also relates in detail how the webs are produced, the booms drilled, and the spars assembled. Illustrations of the equipment used in the various processes supplement the text, while the subject matter is divided into the following headings: web production, routing, assembly drilling, center-section boom drilling, operations on assembled spar, and drilling and milling layout. *Aircraft Production*, December, 1944, pages 599–607, 20 illus.

Avoiding Dimpling Failures in the New Aluminum Alloy-Alclad 75S-T. A. A. Bibee. Reference is made to fabrication problems that appeared with the introduction of Alclad 75S-T to the aircraft industry. It is stated that shallow joggles formed by hand, as well as lightening holes and dimples formed with standard tooling, fractured with alarming regularity. While the alloy is claimed to have a combination of strength and toughness superior to any of the aluminum alloys used until recently by the aviation industry, a microscopic examination of the material before fabrication revealed that its microstructural quality did not compare favorably with that of conventional Alclad 24S-T.

Details are given about a study of the dimpling characteristics of Alclad 75S-T sheets that led to the development of a die design and the establishing of gage limitations that permitted the forming of satisfactory riveting dimples. It is stated that fatigue tests show that Alclad 75S-T dimpled and riveted panels compare favorably with the conventional Alclad 24S-T fabricated with standard dimpling sets. *The Iron Age*, December 21, 1944, pages 38–43, 22 illus.

Records Keep Everybody Quality Conscious. H. A. Bartholomaei. The quality-control system employed by the Bendix Radio Division of Bendix Aviation Corporation is detailed. Besides explaining the various charts, records, and inspections that form the basis of the system, the writer indicates how a bonus plan for employees coordinated with the quality-control program results in an effective reduction of scrap. Differentiation is made between application of the system in primary production, subassembly, and final-assembly departments. Among the forms and charts described are the following: (1) A card for noting the performance of each worker. This lists the pieces produced by each operator which are accepted or rejected by floor inspectors. Reasons for rejects are given. (2) A form giving the total count or cumulative quantity of accepted and rejected parts in runs that continue for several days. (3) A daily report, listing the number of rejects and number of accepted parts, filed with the quality-control supervisor by each floor inspector as a summary of his work. (4) A form sent by the quality-control supervisor to management and supervisory personnel down to shop foremen as a summary report on floor and final inspection the day following collection of data, to advise of total production and per cent of rejects. (5) A weekly analysis and summary, by shifts and by type of tools, of the number of pieces produced and the percentage rejected on floor and final inspection, respectively, in the machine shop. (6) A tag listing assembly operations in order and the number of the operator who performed them, as well as of the inspector who passed the work. (7) A chart for

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statistical control of parts produced on automatic machines over a 5-month period, which is posted in the office of the plant manager and enables him to take action when the percentage of rejects approaches the upper control limits. (8) A chart that shows the ratio of rejects revealed by floor inspection as against final inspection in one department over an 18-month period. (9) A chart demonstrating the percentage of repair and replacement charges relative to direct labor, over a 21-month period in three departments. *Wings*, December, 1944, pages 1313–1318, 12 illus.

South African Contribution. A survey of aircraft spare parts and accessories being manufactured by South African private manufacturing firms and government departments. Among the items mentioned are electrical bomb-release gear, exhaust-manifold pipe systems, light-gage metal fittings for wings and air frames, oil-resistant seals and gaskets, landing-wheel tires and tubes, inflatable dinghies, wing components, and wooden propellers. Others include aircraft-engine assembly stands, engine-test stands, wing trestles, ground-signaling devices, and flare-path torches. In the article emphasis is placed on the fact that all industries that were able to make contributions to the aircraft-parts manufacturing phase of the South African war effort rallied under the emergency. *Aircraft Production*, December, 1944, page 591.

How to Bend Aluminum Tubes and Shapes. Methods of bending aluminum and aluminum-alloy tubing are described. Factors that govern the bending of a tube, including size, shape, and the ductility of the material of which it is made, are discussed. Consideration is given to the conditions causing fracturing, buckling, and distortion during bending operations. It is explained that for limited production aluminum tubing may be filled with a low-melting-point alloy to provide inside support during the bending operation. Also discussed are the use of a "hickey" tee to bend pipe, bending tubing by hand between wooden pegs, the use of a bending form, bending with a roto-stretcher, and the hydraulic bending machine. *The Iron Age*, December 28, 1944, pages 42–45, 9 illus.

Products of Teamwork! The December issue of *Canadian Aviation* contains a series of articles dealing with the manufacture of various aircraft components by Canadian subcontractors. These articles describe the special features that characterize the production methods and equipment of the subject companies.

In addition, there is an article on the operations of one American firm, the Packard Motor Car Company. However, the processes examined in this article are confined to those employed for the manufacture of the British-designed Merlin engine. *Canadian Aviation*, December, 1944; "Tires by Dunlop," pages 82, 83, 9 illus.; "Undercart by Otaco," pages 84, 85, 9 illus.; "Wheels by Kelsey," pages 86, 87, 7 illus.; "Canopy Tops by Clyde," pages 88, 89, 13 illus.; "Fuselages by Canadian Power Boat," pages 90, 91, 5 illus.; "Massey-Harris Makes the Wings," pages 92, 93, 158, 9 illus.; "Merlin by Packard," pages 94, 95, 158, 9 illus.; "Tanks by Aluminum Goods," page 96, 6 illus.; "Tank Covers by Gutta Percha," page 98, 6 illus.; "Tanks of Wood," page 100, 6 illus.; "Fins by Humber," page 102, 5 illus.; "Lanc Wings by Fleet," pages 104, 106, 8 illus.; "Hydraulics from Windsor," pages 109, 156, 5 illus.; "Empennage by C. G. E.," page 110, 6 illus.; "Bomb Doors by Ottawa Car," page 114, 4 illus.; "Controls by Bloctube," pages 116, 118, 8 illus.; "Oleo Legs by Genelco," pages 120, 122, 156, 11 illus.; "Fuselages by Cocksutt," pages 127, 156, 5 illus.; "Boeing Makes Stabilizers," pages 132, 134, 7 illus.

A completed cowl for the P-40 Thunderbolt showing the primary and secondary rings and mechanisms.

Pre-Production Technique. H. G. Barnett. This is a study of Bristol Aeroplane Company techniques in applying the Robinson A.C.T. lithographic process for full-scale layout and template reproduction. Demonstrating how the use of this process makes possible the elimination of a large amount of detailed drawing work on certain types of airplane parts, the writer outlines the procedures by which lines are laid down full size on metal sheets and faired as necessary, layouts are made of various structures, and templates are printed. A brief review of the A.T.C. process and its applications, which precedes the investigation of Bristol company practices, serves to indicate improvements that have taken place in this lithographic method of reproducing layouts since it was first devised. In addition, some of the more apparent advantages to be derived by laying out lines, assemblies, and details of plate work full size and true to scale and then reproducing them on template material are summarized. *Aircraft Production*, December, 1944, pages 575–579, 7 illus.

Increasing Die Longevity by Chrome Plating. A description of how the life of dies used for stamping identification marks on aluminum aircraft parts can be increased by chrome plating. It is explained that, because of the abrasive action of the aluminum oxide film on the parts to be stamped, steel stamping dies wear out rapidly. It is stated that the wear of stamping dies can be reduced, at a fraction of their initial cost, by the application of flash chrome plate to the tip of the die and that this does not alter the heat-treating requirements of the steel. *Industrial Aviation*, December, 1944, page 70, 1 illus.

Aluminum Bronze Extrusions. Frank J. Miller. Reference is made to the great impetus the demands of the war effort have given to the use of extruded aluminum bronzes by the air-

craft industry. The methods and equipment for extruding these mechanically desirable but hard-to-work aluminum-bronze alloys are described. Information is given about the types of aluminum-bronze that have been found satisfactory for fabrication by extrusion. Of particular importance is a high-iron, high-aluminum type widely used for aircraft-engine, landing-gear, and controllable or variable-pitch propeller parts. A description is given of the extrusion equipment, located at the Wrought Products Division of Ampco Metal, Inc., for this type of fabrication. It is built around a hydraulic horizontal-type Schloemann press, having a capacity of 2,275 tons total pressure on the main ram, and further equipped for tube extrusion with piercer attachment of 275 tons. Operating details are discussed. Extrusions and sand castings are compared. Included is a table of the properties of typical sand-cast and extruded aluminum-bronze alloys. *Metals and Alloys*, December, 1944, pages 1598–1603, 8 illus.

Mirror-Image Template Reproductions. C. F. Reupsch. This article describes a method of utilizing the offset litho process that enables template makers to produce "mirror-image" patterns from loft layouts. It is stated that while the method, which was developed by Consolidated Vultee Aircraft Corporation, cannot be called foolproof, it has produced reasonably good results and has made it possible for the company to save hundreds of man-hours in duplicating templates. *Automotive and Aviation Industries*, December 1, 1944, pages 26, 27, 62, 64, 4 illus.

Tap Grading System Reduces Scrapped Threads. C. D. Savage. An account is given of how the Wright Aeronautical Corporation has reduced scrap caused by torn and oversize threads, by predetermining the actual cutting size of a tap for a specific material prior to placing the tap on a production job. It is stated that tap grading has also greatly reduced lost time attributable to premature tap failure. A series of carbide-thread plug gages in steps of 0.003-in. are used in a test block for checking the thread produced. *The Iron Age*, December 28, 1944, pages 38–41, 1 illus.

The Mass Production of P-47 Cowlings at American Stove. S. J. Szabo. The adaptation of processes and equipment is noted in this account of how the American Stove Company converted one of its plants from the manufacture of gas ranges to the production of cowlings for the Republic Thunderbolt. A feature of the conversion that is stressed is the application of press operations, so prevalent in stove manufacture, to the making of more types of parts than had been thought possible in aircraft construction. The system of maintaining a continuous flow of materials is another feature of the company's cowling-production methods to which attention is directed. Procedures for drawing the sections for the large outer shells of the cowling in one operation are marked. The article also mentions new equipment installed by the company when the production of aircraft components was initiated. *Aero Digest*, December 1, 1944, pages 89, 90, 3 illus.

Propellers

A Master Thrust-Curve for Airscrews. V. D. Naylor. The writer first refers to the fact that those engaged in propeller work are constantly making use of the tables of k_t and k_q for different values of J, given in *British Ministry of Aircraft Production R. & M. No. 1673*, and notes that in using these tables it is usually necessary to extrapolate. He then shows that where there is strict ground for comparison it is possible to construct a single thrust curve, which covers a wide range of pitch and conditions of working, and so obviate the need for extrapolation. The curve found covers the range of pitch $p/D = 0$ to 1 and the working range below stall. *Aircraft Engineering*, November, 1944, pages 310–312, 5 illus.

Propeller and Gear Ratio Requirements for Aircraft Designed for Cruising Operation. R. S. Schairer. It is stated that, in order to utilize the power of the engine as efficiently as possible, the propeller and the propeller drive-gear ratio must be properly chosen to fit the particular airplane and engine. The best combination of propeller and gear ratio for any engine depends on the type and general arrangement of the airplane in which the engine is installed. For aircraft designed for cruising operation it is important that there be high propulsive efficiency at the proper engine speed for minimum specific fuel consumption for almost all cruising conditions. For a given airplane with a single-stage, two-speed engine supercharger there is ordinarily more than one combination of propeller diameter and gear ratio that gives within 1 per cent of maximum propulsive efficiency for all cruising conditions up to an altitude of 20,000 ft. and up to maximum cruising speed. Of these combinations, that one is best which has the largest diameter and the lowest ratio of propeller speed to engine speed, because it gives the best take-off and climbing performance. *SAE Journal*, December, 1944, pages 592–597 (Transactions), 3 illus.

Radio

I'll Fly with Radio Regardless. Sydney Nesbitt. Consideration is given to the following questions: (1) When will the present low-frequency radio ranges and control towers be replaced by ultra-high-frequency equipment? (2) How long will it take to effect change-over from present low-frequency equipment in private aircraft to new ultra-high-frequency equipment? (3) What will be the status of regulations? Comments are made concerning probable designs and types of radio equipment, standardization and interchangeability, licenses, and Federal regulations. *Aviation Maintenance*, December, 1944, pages 78, 79, 154, 158, 164.

Very High-Frequency Radio-Noise Elimination. T. B. Owen. This paper outlines generally the principles of radio noise elimination at all frequencies, and shows how these same principles apply specifically at extremely high frequencies. Basic concepts are discussed in such a manner that radio-noise test procedure can be made a matter of routine. An outline of test procedure for engine ignition systems is given, and the remedial measures necessary are indicated. The whole procedure is based on the concept of determining the coupling path into the receiver, with the idea that once this is known the method of eliminating the coupling path is best reached by a consideration of the construction of the airplane under test. *Electrical Engineering*, December, 1944, pages 949–954 (Transactions), 3 illus.

Reaction Propulsion

The German Long-Range Rocket. Details of the V-2 rocket projectile are revealed in this article. A diagram shows the general design of the projectile, which is stated to have a length of 46 ft., a diameter of 5½ ft., and a sharply pointed nose. The rear of the projectile carries four large external stabilizing fins at right angles to each other. The main assemblies contained in the shell-like structure are listed as (1) nose, which contains an explosive warhead of 2,000 lbs.; (2) a compartment containing control equipment; (3) two large aluminum fuel tanks, one holding about 7,500 lbs. of alcohol and the other about 11,000 lbs. of liquid oxygen; (4) a turbine and pump assembly with a gas generator to drive the turbine; (5) a large combustion chamber and venturi, into which the alcohol and liquid oxygen are forced through a series of jets; (6) two sets of control vanes, one of which operates internally in the jet stream and the other externally on the edges of the four stabilizing fins.

It is noted that, since all power is obtained from the fuel carried and external air is not required for combustion, the rocket can operate equally well at extremely high altitudes where there is practically no air present. The method of launching the rocket is explained and information is provided regarding how it is controlled. The rocket starts by climbing vertically, but a gyroscope control within the projectile automatically comes into play to operate the control vanes, and thus to cause the projectile to curve away from the vertical towards the target. The mechanism is so arranged that the rocket is pointing upwards at an angle of about 45° about 1 min. after launching; at this time the fuel supply is cut off, either by remote radio control from the ground or by preset automatic instruments in the rocket. The point at which the fuel is cut off determines the range of the V-2.

Warehouse on Wings

If all his sources of supply were just across the street, a retailer could cut inventories to the bone, yet never miss a sale. Now, by specifying delivery via air, a merchant can in effect move those warehouses next door. Ordering just ahead of the market, he can ride the peak of a season, or a style, or a rush for a new product. His capital turnover is rapid; he needs less credit. Overstocking of highly expensive or seasonal items is avoided.

But the list of items which can move economically in the warehouse on wings is not long enough at present. The job now is to explore all fields of merchandising, to find more goods which can travel via air with benefit both to merchant and to air carrier.

Still another job is to bring rates down so additional goods can move economically via air. Such rates evolve from maximum efficiency of operation and also from full payloads. Wright Cyclone engines, with a payload bonus due to their lower weight ratio, and with ease of maintenance and low fuel consumption to provide efficiency, are helping to make such rates a reality.

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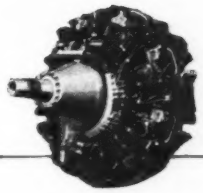

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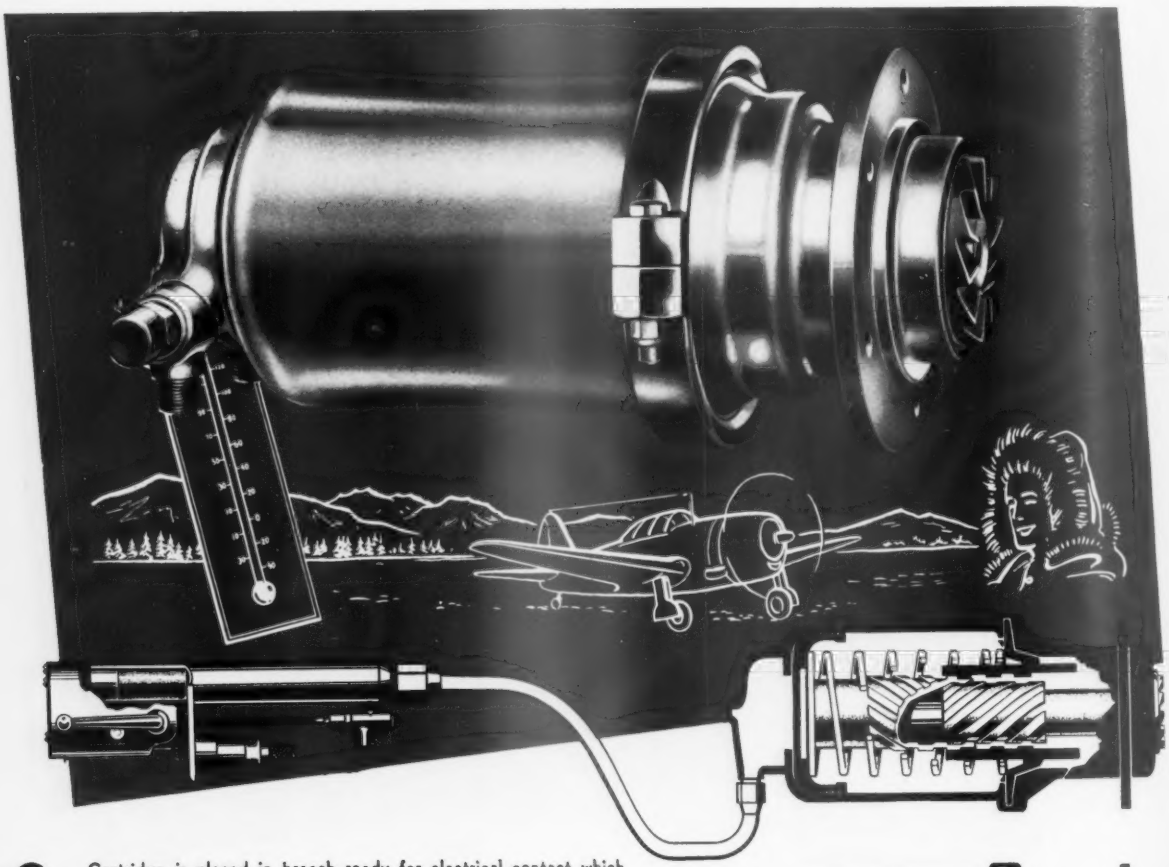

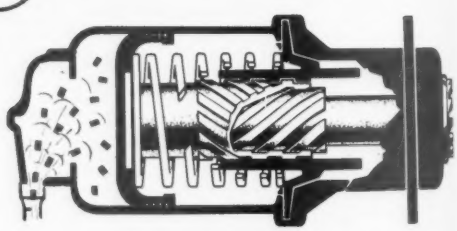

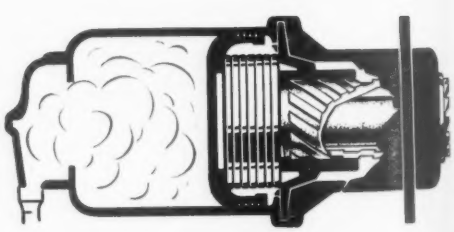

1. Cartridge is placed in breech ready for electrical contact which will ignite quick-burning powder and drive slow-burning pellets into combustion chamber.

2. Combustion is completed in combustion chamber, rapidly building up pressure of gases on piston. Power stroke begins while helical splines impart accelerating rotary motion to clutch jaw.

3. As power stroke is completed, clutch jaw has spun engine through 3 revolutions. Exhaust valve in head opens and helical spring returns piston to starting position.

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It is noted that, since the rocket is pointing upwards at about 45° when the fuel is cut off and is traveling at a speed of about 3,000 m.p.h., it continues upwards, following the same path that would be taken by a shell fired at this angle. There is little air resistance in this region, so that eventually it reaches a height of over 60 miles above the earth's surface, and comes down still following the same parabolic path that a shell would take. The speed is much greater than the speed of sound, so that the noise of the passage of the V-2 is not heard until after it explodes. *The Engineer*, December 15, 1944, pages 476, 477, 2 illus.

Reconversion

Converting Light Military Planes for Personal Use. Jack P. Lysdale. Information is provided for those who expect to purchase military aircraft and convert them for personal use. The writer describes the operations necessary to convert the Taylorcraft L2M, the Aeronca L3, and the Fairchild PT-19. *Aviation Maintenance*, December, 1944, pages 56, 57.

Rotating Wing Aircraft

Principles of the Helicopter. Part II. Alexander Klemin. In this second of a series of articles about the helicopter a qualitative analysis is made of various types of helicopters that have been proposed. Those that are described and appraised include helicopters marked by the following features: (1) Tail rotor to counteract torque; (2) two rotors on either side of the fuselage; (3) two overlapping rotors at either side of fuselage; (4) two superimposed coaxial rotors; (5) rotors in tandem; (6) rotors in tandem with overlap; (7) rotors in tandem rotating in the same direction; (8) surfaces in the slipstream of an auxiliary propeller; (9) surfaces in the slipstream of the main rotor; (10) four rotors, tandem and side by side; (11) rotor with engine and airscrew placed at the blade tip; (12) jet propulsion with compressed air; (13) jet propulsion using exhaust gases; (14) jet propulsion engine at the tips of the blades; (15) air-jet discharge at tail; (16) offset propulsive airscrew; (17) propulsion without inclination; (18) helicopters with auxiliary airscrews for control; (19) combined airplane and helicopter; (20) direct-lift aircraft with oversize propulsive airscrews; (21) paddle-wheel type of helicopter or cyclogiro.

The writer offers the following opinions based on present conditions: (1) the evolutionary history of other vehicles of transportation—sea, rail, automotive, and air—indicates that "extraordinary" solutions, such as engine-propeller units mounted at the tip of the blade or the cyclogiro, are never likely to be the successful ones. (2) The class of aircraft that makes use of an oversize propeller may well be built with moderate success. This type is likely to fail, giving neither the extreme of speed and efficiency of the airplane nor the complete mastery of vertical travel of the helicopter. (3) The design of a combination helicopter-airplane seems fraught with difficulty. No one can say definitely that such combinations are worthless until a first-rate engineering and manufacturing company has carried through such a development with skill and full resources, but the type does not appear promising for the present. (4) The types or configurations on which it would appear wisest to concentrate attention at the moment are those which depart least from the simplest conceptions. Such configurations are the single rotor with compensating tail rotor, two coaxial superimposed rotors revolving in opposite directions, and two rotors disposed on either side of the fuselage. Less likely to deserve attention is the arrangement of two rotors in tandem. (5) No matter how such configurations are analyzed on paper, it will not be possible to say which of them will be superior, nor is it possible to say that such configurations limit the field, without years of engineering effort and service test. (6) The jet-reaction helicopter, where jet reaction is used solely as a means of counteracting the torque of the main rotor, may perhaps be an appropriate formula for helicopters in which high speed or high-speed cruising are to be sought at the expense of other qualities. (7) The jet-reaction rotor, where a compressor or fan is to be driven by a reciprocating internal-combustion engine and air is to be led to the tips of the wings, is not promising unless additional factors are brought into the situation. On the other hand, it would appear wise to watch the development of the turbojet engine and of the simple "air ramming" type of jet-propulsion engine such as is used on the German robot planes. *Aero Digest*, December 15, 1944, pages 82–84, 128, 130, 132, 17 illus.

Boston Sky Party. Charles C. Layman. An announcement of the helicopter's use for experimental purposes for commercial delivery is accompanied by some brief details about the helicopter employed—the Model A-1 produced by Aeronautical Products, Inc. The experiment was a demonstration delivery flight sponsored by a Boston department store. The helicopter is described as being powered by a 130-hp. air-cooled engine that gives it a cruising speed of about 85 m.p.h. Its rotor describes a 30-ft. circle and a small vertical tail rotor is used to counteract the torque and to facilitate steering. With the engine mounted forward, the power is transmitted to the rotor through a chain drive and gear box. The article also includes some data about another helicopter that the same company is contemplating. *Skyways*, January, 1945, pages 41, 88, 2 illus.

Stress Analysis

Three-Dimensional Analysis of Engine Mount Rings by a Strain Energy Method. Charles E. Mack, Jr. A strain energy method for the determination of bending and torsional moments in a circular engine mount ring is presented. The analysis given is for the three-dimensional case in which bending normal to the plane of the ring, bending in the plane of the ring, and torsion of the ring occur simultaneously. The known external loads on the system consist of vertical, side, and drag forces together with yawing, pitching, and rolling moments.

The method is based on the fact that the total elastic energy stored in the system of engine, ring, and mounting tubes must be a minimum. The equations of static equilibrium are first written down. The energy in the mounting tubes and in the rubber of the engine supports is then calculated. To determine the energy in the ring, the bending and torsional moments are developed in general terms. Through the use of these expressions, the minimization of the total energy is shown to lead to a set of equations, linear in the unknown forces and moments, which contain just 14 characteristic integrals associated with the ring itself. The component parts of these equations can be listed by rule as soon as the geometry of the structure to be analyzed is known.

The paper attempts to develop equations sufficiently general to be readily adaptable to any closed circular ring, under nondistributed loads, which is capable of taking bending. The possibilities for further extension, as well as for specialization of the analysis, are briefly considered. *Journal of the Aeronautical Sciences*, January, 1945, pages 1–13, 8 illus.

A Note on Bending Beyond the Proportional Limit. M. Yachter. Most theories of bending in the plastic range are based either upon the assumption of linear strain variation across the depth of the beam or by fitting some equation to the stress-strain curve.

In this paper the following problem is solved: Assuming the principle of minimum strain energy to be valid over the entire range of the stress-strain curve, find the exact stress distribution over the depth of a beam in pure bending (or combined bending and axial load, provided strain energy caused by axial load and beam column effects are neglected) *compatible with equilibrium and minimum strain energy*.

Mathematically, this problem leads directly to a rather simple isoperimetric problem with variable limits in the calculus of variations. The solution leads to the construction of an auxiliary or generalized stress function, intimately connected with the actual stress through certain simple characteristics of the

stress-strain curve (moduli ratios) and reducing to the actual stress for all values below the proportional limit. It is shown that the exact stress distribution, in the sense that it is compatible with equilibrium and minimum strain energy, is such that its associated generalized stress distribution is again *linear* across the depth of the cross section.

Once the associated generalized stress (as a curve vs. stress) has been determined from a given stress-strain curve, it is a comparatively easy matter to calculate maximum resisting moments for a given section on the basis of any limiting maximum fiber stress. Examples of such calculations for stainless steel and comparisons are given in the test. *Journal of the Aeronautical Sciences*, January, 1945, pages 21–30, 17 illus.

Mechanical Properties of Magnesium Alloy Tubing. R. T. Schwartz and G. M. Martell. This paper presents the mechanical properties of extruded round, seamless magnesium-alloy tubing, containing 6.55 per cent aluminum, 1.04 per cent zinc, and 0.30 per cent manganese, which analysis is similar to that for Dowmetal J and AMC 57S. The tubing was characterized by a low ratio of proportional limit to ultimate strength in tension and a low proportional limit and yield strength in compression compared to those in tension. The tensile and compressive testing presented certain difficulties because of low shear resistance and sensitivity of the material to stress concentration. The marked difference between the stress-tangent modulus data for tension and compression and the correlation of the latter with column properties for knife-edge and flat end conditions are emphasized. Torsional properties were also determined.

Although the tests were made a few years ago, the data still are believed to reflect, in general, the characteristics of the wrought and extruded magnesium alloys of high tensile strength, and it is believed that the data are of value to illustrate certain characteristics typical of these alloys for aircraft structural applications, as well as to point out some of the difficulties of testing. *Journal of the Aeronautical Sciences*, January, 1945, pages 31–38, 11 illus.

A Graphic Solution for Strains and Stresses from Strain Rosette Data. Roberto Contini. This paper gives a simple graphic construction applicable to strain-rosette data obtained from the two most common types of rosettes, which are designated as (a) the equiangular strain rosette, and (b) the 45° strain rosette with three or four gages.

This construction gives a complete description of the state of strain at the point where strain measurements are taken, and it can be easily modified to describe the state of stress if the strained material is elastic and isotropic. To a large extent the construction presented in this paper performs graphically the same operations as the electrical computers perform electrically.

A detailed proof of the graphic construction is given at the end of the paper. *Journal of the Aeronautical Sciences*, January, 1945, pages 47–50, 5 illus.

Bearing Strength in Airplane Design. Albert Epstein. Allowable bearing stress is a value based on an arbitrary amount of deformation of a body subjected to a bearing pressure. There is no fixed value for a particular material, the value depending upon the degree of restraint of surrounding fibers to the flow of the material under the direct bearing pressure. The allowable stress for aluminum alloys is generally associated with the elongation of a hole in a plate subjected to uniform bearing pressure from a pin. The stress thus obtained is considerably less than the stress that may be used as the allowable bearing pressure on a rivet or on the wall of a tube in a socket joint.

The bearing stress criteria for aluminum alloys, if applied to heat-treated steel, would permit allowable stresses as much as 50 per cent greater than those used at present for steel.

In bolted joints consideration should be given to the permanent elongation that may occur in the bolt hole after the joint is subjected to limit load. Appreciable set may reduce the service life of the joint, especially when the joint is subjected to shock or vibration.

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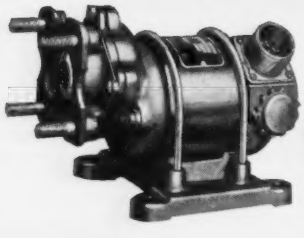
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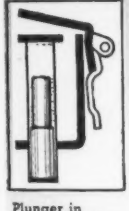
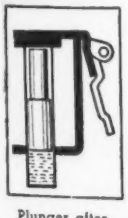


Plunger in normal position at bottom of cylinder.



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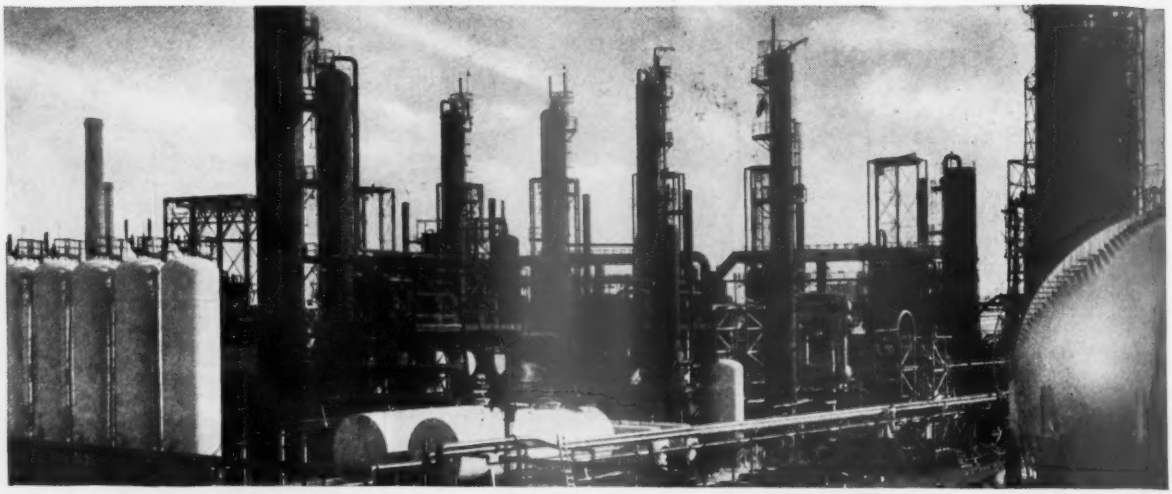

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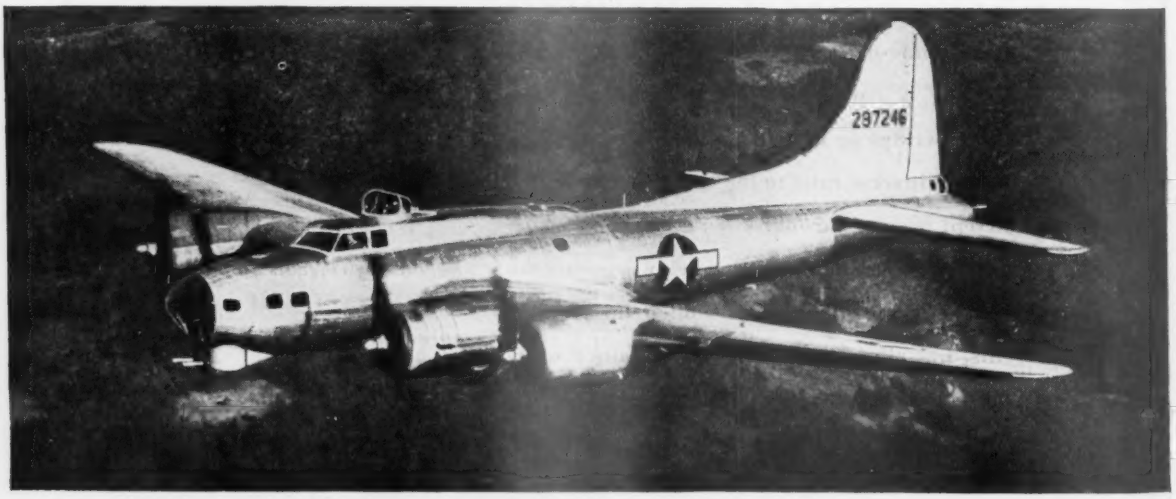

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The allowable strength values for some single-rivet joints may be almost as high as the acting failing strength. In several applications, described in this paper, it is desirable to use some factor or margin of safety with these values because of discrepancies between computed and actual rivet loads.

The load-deflection characteristics of riveted joints are important in themselves, and they, rather than the allowable strength, may be the controlling factor in some phases of the design. The greater the deflection, the poorer will be the torsional rigidity of a wing. High joint deflection may reduce to an appreciable degree the effectiveness of wing skin in carrying tension loads. *Journal of the Aeronautical Sciences*, January, 1945, pages 67–84, 14 illus.

A Simplified Analysis of Hollow Beams with Longitudinal Webs Subjected to Torsional Loads. Eryk Kosko. The Maxwell-Mohr method, in general use in connection with statically indeterminate trusses, is applied here to the problem of the prismatic thin-walled beam with internal longitudinal webs, subjected to a constant torque. In comparison with other methods known to the writer, the analysis outlined in the paper presents the advantage of involving fewer unknown quantities and of being easily adaptable to tabular work. *Journal of the Aeronautical Sciences*, January, 1945, pages 103–107, 4 illus.

Vibrations of Composite Structures. H. Serbin. The purpose of this paper is to show how the method known as "Consistent Deformations" or "Minimum Energy of Deformation" may be applied to solve vibration problems in the analysis of static loads on composite structures. It is stated that the energy methods, which are now widely used and are successful for simple continuous structures, are cumbersome for composite structures. Frequently they are improperly applied.

Although the underlying approach is the same, in application of the method the details will differ because of the dynamic nature of the problem.

The problems involving consistent deformations and harmonic loadings are stated and solved. Examples are worked out mathematically for the determination of the effects of natural frequencies of vibration. It is stated that one of the equations can also be used for the calculation of forced oscillations. *Journal of the Aeronautical Sciences*, January, 1945, pages 108–112, 5 illus.

Factors of Safety—Or of Habit? W. Tye. In opening this article the writer states that engineering habits form slowly, and once formed are slow to change. Some aeronautical customs are so deeply rooted that it is easy to confuse the superstructure of habit with the basic foundations. Some of the customary methods of specifying strength conditions in aircraft are then reviewed, and an attempt is made to untangle underlying principles. The article is confined to the main symmetric flight maneuvers, that is, those that result from an action on the part of the pilot (thus excluding loading caused by atmospheric gusts) and involve motion in the pitching plane only. Sections of the article discuss the older method of basing airplane design on a limited number of selected stressing cases; present practice and the use of "envelope" cases; the *V-G* recorder and its functions in recording flight speeds and normal accelerations; the frequency of occurrence of external loads; proof and ultimate failure; factors of safety; and structural variation. Following the discussions, the writer lists trends that are becoming a practical possibility, as (1) the use of the *V-G* data to establish the general shape of the design *n-V* diagrams based on normal acceleration and flight speed; (2) the selection of an *n-V* boundary of given frequency of occurrence associated with ultimate factors of 1.5; (3) the use in design of stresses more closely related to the actual properties of the materials. Probable future trends are also discussed. *The Journal of The Royal Aeronautical Society*, November, 1944, pages 487–494, 4 illus.

Predicting Ultimate Failure Loads. Leon Beskin. Methods of stress analysis for the accurate prediction of ultimate allowable loads in machine and structural design, especially in the aircraft industry, are discussed. It is stated that the margin of safety against failure by fracture depends on the plastic behavior of material rather than the elastic action commonly assumed in calculating working stresses. The writer shows how methods derived from the theory of plasticity can be developed to predict ultimate allowable loads. Using a simplified assumption, he develops equations and charts for predicting the ultimate failure loads of parts subjected to bending and to eccentric loading. A table gives data for computing modulus of elasticity and elastic bending for various shapes and sections of construction forms. A discussion is given of the use of interaction formulas for computing margins of safety. The results established are applied to the following problems: bending of symmetric sections around their axis of symmetry; bending of symmetric sections around an axis perpendicular to the axis of symmetry; eccentric loading of symmetric sections, the eccentric load being applied at a point on the axis of symmetry; unsymmetric bending of symmetric sections and bending of nonsymmetric sections; eccentric loading without symmetry; simplified method for general bending and load. *Machine Design*, December, 1944, pages 117–124, 13 illus.

Tensorial Analysis and Equivalent Circuits of Elastic Structures. Gabriel Kron. Equivalent circuits are developed for one-, two-, and three-dimensional elastic structures that enable their solution by means of a network analyzer under steady small deformation and under forced or natural vibration. The elastic structure is assumed to consist of long, thin beams and rigid bodies having different elastic coefficients (tension and shear, bending and twist) along three perpendicular directions and interconnected into an arbitrary network, either rigidly or by various constraints, such as pin joints, hinges, rollers, etc., in any combination.

Southwell's relaxation method is given for the approximate numerical solution of structures, and a tensorial method is presented for their exact solution. Both methods employ matrices to systemize and speed up the calculations. *Journal of The Franklin Institute*, December, 1944, pages 400–442, 19 illus.

Network Analyzer Solution of the Equivalent Circuits for Elastic Structures. G. K. Carter and Gabriel Kron. The equivalent circuits of elastic structures developed in the foregoing companion paper are numerically checked for two known frames. Both structures are also measured on the a.c. network analyzer for the case of known impressed forces. In each case the measured values checked satisfactorily with the calculated values, showing that existing analyzers can be used to good advantage to determine the forces and displacements in statically indeterminate structures. *Journal of The Franklin Institute*, December, 1944, pages 443–452, 8 illus.

Strain Gauging in Aircraft Engineering. John S. Trevor. A review of the development of strain gaging in which early methods are outlined and the introduction of advanced methods is described. The article has particular reference to the application of strain gages for the measurement of vibratory stresses on aircraft propellers. A specimen of strain gage recording is illustrated. *Aeronautics*, December, 1944, pages 51, 52, 3 illus.

Two-Spar Wing Stress Analysis. W. J. Goodey. An investigation carried out to determine whether or not the assumption that flexibility of the ribs has no appreciable effect on the distribution of stresses in the wing is actually justifiable. Such a condition was assumed by the writer in previous two-spar wing stress analyses. The analysis is limited to the case of a rectangular box of constant cross-section, with or without an open portion at the inner end. Three cases of loading are considered—a concentrated torque applied at the tip, a concentrated torque applied at the inner end of the skin-covered portion, and a torque uniformly distributed over the whole span. In order to simplify the basic equations as much as possible, the strain energy caused by direct stresses in the skin covering is neglected. It is shown in an appendix that this makes no difference in the general character of the stress distribution. The results obtained are compared with the corresponding cases with rigid ribs. *Aircraft Engineering*, November, 1944, pages 313–319, 9 illus.

Superchargers

The Design and Operation of Superchargers. A. J. Penn. The writer opens this paper with a rather

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detailed outline of the design of the centrifugal type of supercharger, which, it is noted, is the type universally adopted for the modern aircraft engine. In this section he discusses the design factors involved in inlet, impeller, diffuser, and the delivery volute. Consideration is then given to the theory of the centrifugal supercharger, its performance and calibration, and the effect of supercharging on aircraft-engine performance. Drawings and graphs illustrate the points brought out in the text. *The Journal of The Royal Aeronautical Society*, November, 1944, pages 495–509, 12 illus.

Testing

U.S. Navy Accelerated Service Testing. C. Fink Fischer. The operation of the newly commissioned service test department of the Naval Air Station at Patuxent River, Md., is described. It is explained that the objective of this department is to subject several of each new-model naval aircraft to as nearly as possible the same service experience and usage as it would undergo during its life in an operating fleet squadron and, from this experience, to recommend (a) changes in design and material, (b) improved maintenance and operating techniques, and (c) the kind and quantity of aircraft spares to be stocked, so that the greatest possible percentage of fleet aircraft may be maintained in fighting condition. In order that it may be of value to the fleet, this mission must be highly accelerated and is accomplished for each model in a limited period of several weeks. *Aviation Maintenance*, December, 1944, pages 44, 45, 132, 7 illus.

Consolidated Designs an Airflow Laboratory. The purpose, construction, operating principles, and equipment of Consolidated Vultee Aircraft Corporation's airflow laboratory are described. Making it both possible and practical to determine the efficiency of engine air ducts and similar equipment on the ground, this laboratory also enables design engineers who would not ordinarily participate in test flights to visualize more clearly the functions of the equipment they create. The power plant for the airflow laboratory is a large marine engine, housed in a wooden shelter and supported by a converted truck chassis. The drive shaft of the engine projects outside of the shelter and has a suction fan directly attached to its extreme end. Covered by an air-exhaust and damper-flow control unit, which enables it to pick up an adequate supply of free air for the laboratory equipment, this fan generates the flow of air used for testing. The actual airflow testing is accomplished in a comparatively large wooden test chamber, having screened air inlets to insure ideal test conditions. An attachment box with two attachment plates connects the test chamber to a static chamber whose purpose is to reduce flow pulsations. Test specimens pass the required flow of air through special adapter connections with the attachment plates. *Western Flying*, December, 1944, pages 58, 114, 2 illus.

Testing Equipment

Fatigue Testing Apparatus. A description is given of fatigue testing equipment manufactured by W. & T. Avery Limited, Birmingham, England. Details are given about two types of machines for the testing of revolving specimens under load, that is, under bending stresses. They are designed for tests of small specimens of material. Other equipment described includes the "Duplex" revolving cantilever testing machine and the "Pulsator" dual-mass resonance machine. *Aircraft Engineer*, November, 1944, pages 334, 335, 8 illus.

Strain Gages and Magnetometers in Aircraft Testing. Esther H. Forbes. How the facilities and experience of the Waugh Equipment Company in manufacturing railway equipment was applied to airplane-testing equipment is described. One of the devices developed was a vibration-testing machine for testing aircraft structures on the ground and in flight. A description is given of one of the twelve vibration machines, known as Model VMJ-3C, which produces a circular motion. It is able to create circular, elliptical, or horizontal linear motion for testing such aircraft instruments as altimeters, pressure gages, speed indicators, bomb selectors, turn-and-bank indicators, clocks, and compasses. A large variety of strain gages, vibration pickups, and oscillographs has also been developed. The various types of these instruments are discussed, with information about their construction and application.

Another instrument described is the magnetometer, designed to measure the strength of magnetic fields. Details are given about the construction and operation of this instrument. Still another instrument described is the gradientometer, which is reported to be more rapid in use than the magnetometer. *Western Flying*, December, 1944, pages 88, 90, 108, 109, 2 illus.

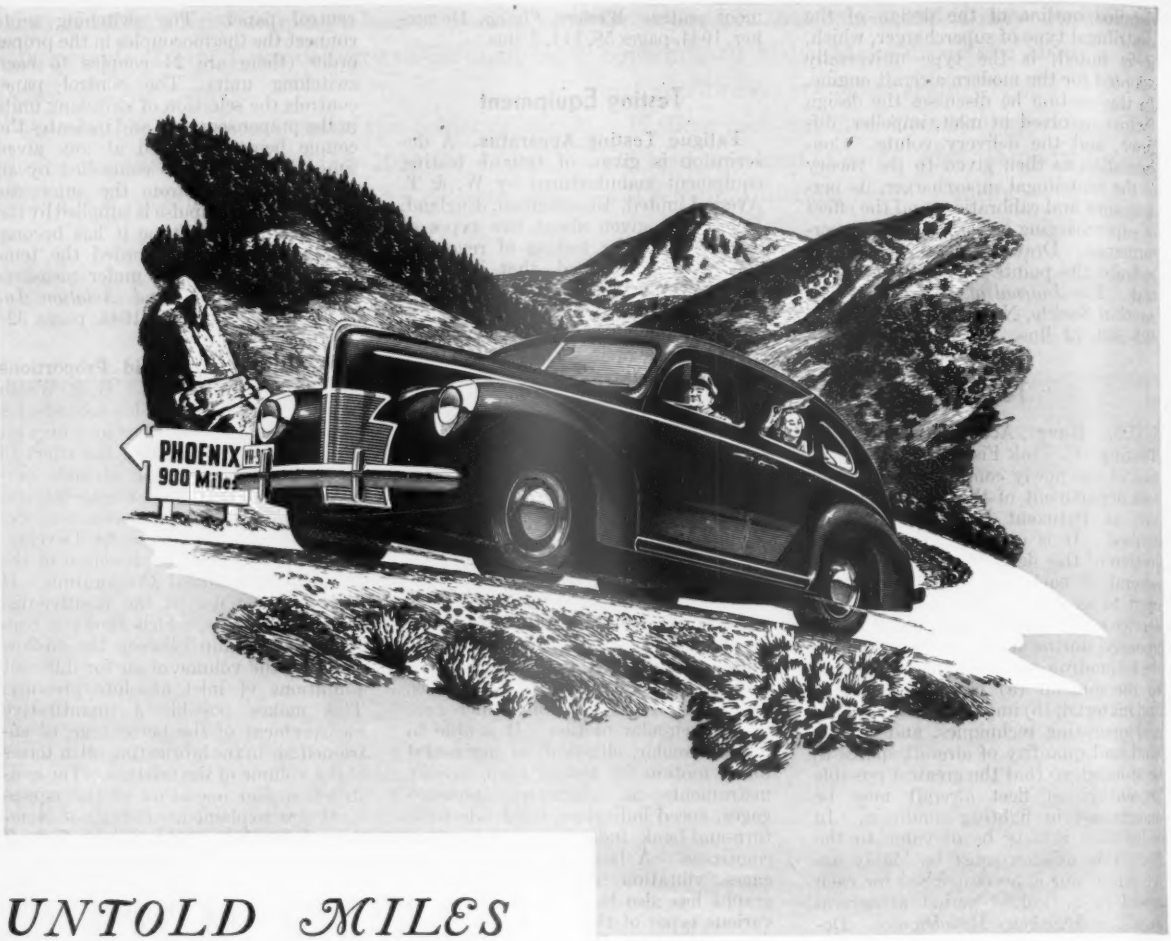
Automatic Temperature Recording Control System. Morton E. Moore. This article describes an automatic control system for use with recorders, which makes it unnecessary for the flight engineer to switch from point to point and record readings on a data sheet. It is noted that the success of the development is largely credited to the cooperation between the men in the Douglas Research Laboratories, who built the apparatus, and the flight engineers who used it. It is stated that the system makes it possible to obtain more temperature information in a shorter time and at the same time leaves the flight engineer free to spend the major portion of his time at other duties. The system is designed to enable an automatic temperature recorder to measure and record a series of temperatures automatically in a regular sequence. It consists basically of a number of switching units and a master control panel. The switching units connect the thermocouples in the proper order (there are 24 couples to each switching unit). The control panel controls the selection of switching units in the proper sequence and indicates the couple being measured at any given time. The system is controlled by an impulse obtained from the automatic recorder. The impulse is supplied by the instrument at the time it has become stabilized and has recorded the temperature of the point under measurement. *Automotive and Aviation Industries*, December 15, 1944, pages 32–35, 70, 72, 74, 10 illus.

Measuring Air-Liquid Proportions in Lubricating Systems. B. R. Walsh and G. S. Peterson. This second of a series of articles describes an indicator designed for investigating the effect of air entrainment on the altitude performance of the aircraft-engine lubrication system. The indicator was developed by the Gulf Research Development Company at the direction of the Wright Aeronautical Corporation. It embodies the use of the positive-displacement pump, which shows a constant relationship between the oil-flow rate and the volume of air for different conditions of inlet absolute pressure. This makes possible a quantitative measurement of the percentage of entrained air in the lubricating oil in terms of the volume of the mixture. The construction and operation of the equipment are explained. *Industrial Aviation*, December, 1944, pages 7–9, 7 illus.

Tools and Equipment

Accurate Assembly of Threaded Valve Seats and Studs. A brief article describes how exhaust-valve seats are screwed into the forged cylinder heads of 2,200-hp. Wright radial engines by the use of Scandia torque machines. It is explained that until recently the exhaust-valve seats, like the intake seats, were shrunk into place, but experiments showed that longer seat life, improved valve action, and easier replacements could be obtained by using a screwed-in seat. Another type of torque machine is used for driving studs into oil-pump bodies, crankcases, and other parts. Uniformity of fit is obtained and overstressed metal is avoided. *Machinery*, December, 1944, pages 199, 200, 2 illus.

Shankless Twist Drill Introduced. This article describes a high-speed steel drill with a continuous flute that is driven by a removable taper shank generally furnished with a Morse taper to fit the spindle of the operating machine or drill press. It is noted that this drill has been manufactured by the Ford Motor Company for its own use for over 6 years, but is being made available publicly for the first time by the Republic Drill & Tool Company, of Chicago. It is explained that the flutes are formed by twisting roll-formed bar stock instead of milling them out of a solid bar, and that the unconventional method of manufacture gives the drills



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greater strength and toughness. *The Iron Age*, December 21, 1944, pages 59, 136, 4 illus.

If You Can't Buy It Make It—Better. George Warde. An account is given of how American Export Airlines built certain important units for its instrument shop when test equipment was unobtainable because of wartime conditions. Information is also given about how the layout of the shop was planned to overcome problems of limited space. The group of homemade units described includes: a rectifier for supplying d.c. power throughout the entire shop; high-altitude test chambers; an octant collimator; a chronotachometer; and a manometer adaptation for checking and calibrating airspeed indicators. *Aviation*, December, 1944, pages 144, 145, 3 illus.

Training

Near Heroes. Martin Caidin. This article deals with the training accorded to 9,000 Civil Air Patrol cadets who were selected to spend 1 week as part of the Army at U.S.A.A.F. bases. Indicating the value of their instruction to the United States and to the future, it tells of the military aviation rudiments they absorbed at the bases' control towers, Link trainers, weather rooms, pressure chambers, etc. *Air News*, December, 1944, pages 34, 76, 4 illus.

A College of Aeronautics. This outline gives the salient points of a report made by the British Inter-departmental Committee regarding the establishment of a School of Aeronautical Science. Fifteen recommendations contained in the report are summarized. These tell of the purposes of the college, the courses and instruction it would encompass, the number of students it would accommodate, standards of admission, requirements for its faculty and staff, how it would be governed, where it would be established, layout plans for permanent buildings and equipment, the money needed for financing it, etc. In addition to the summary, the article discusses at greater length some of the proposals made in the report. A chart illustrates the suggested organizational plan of the college, showing the different departments grouped under six main subjects: flight; aircraft equipment; aircraft structures, engineering and design; aerodynamics; engines and systems of propulsion; and production, administration, and maintenance. *Flight*, November 16, 1944, pages 530–533, 2 illus.; *Aircraft Production*, December, 1944, pages 597, 598.

Keep Those Contract Schools Going. Earl D. Prudden. A plea is made for the continued use of commercially operated flying schools in the Army Air Forces primary training program. It is claimed that, besides resulting in the training of the desired number of military pilots at lower cost and with greater efficiency, such a measure would develop a broad civilian base for overnight expansion of the Air Forces if necessary. Certain benefits derived from the widely scattered location of the civilian schools are also indicated. As a basis for establishing the desirability of continuing the program, the writer refers to the commercial operators' record during their recent participation in the Air Forces primary training program. He states that the commercial flying-school contractors have not only effected great financial and man-power savings for the Government but have also reduced the accident rate for primary training and achieved a graduation rate for cadets never before approached. *Aviation*, December, 1944, pages 120, 121, 262, 264, 3 illus.

Boy Scouts of the Air. George R. Reiss. This article describes how American youths are being given basic aviation training in groups of "air scouts" by the Boy Scouts of America. It also reviews the development of this training program. *Air Trails*, January, 1945, pages 32, 33, 66, 7 illus.

Warfare

Gateway to Tokio. Leonard Engel. Demonstrating the need for an imminent Allied landing on the Chinese coast as an important move in the Pacific war, the writer discusses the feasibility of various approaches and ports that might be used for the landing. He also notes the pattern of landing operations that would be followed, calling attention particularly to the part played by air power in such maneuvers. As analyzed by the writer, the Allies have been motivated by three major goals in their drives across the Pacific toward the Chinese coast: (1) to open a direct sea route, which would be the most effective means of providing China with supplies; (2) to sever communications linking Japan with her southern territories; (3) as a military by-product of the first two efforts, to draw Japan's naval power—airplanes as well as ships—into a final and decisive action. *Air News*, December, 1944, pages 36, 38, 76, 78, 1 illus.

R.P. Squadron. John Yoxall. From a flight in a Beaufighter employing rocket projectiles and an account given by the commanding officer of an R.P. Beaufighter squadron, the writer describes a typical operation of a rocket-projectile squadron against an enemy convoy. He explains something of the action of the rocket projectiles, the noises they make, and their "trouble-free" characteristics. In the outline of a typical attack, descriptions are given relative to the preparatory reconnaissance, briefing of the group, the course of action taken by the attacking planes, and the assimilation of information after the raid as to the damage effected. *Flight*, November 2, 1944, pages 468–471, 7 illus.

Holland Invasion. Ralph Michaelis. A report of the Allied air-borne invasion of Holland. Calling this invasion the greatest air-borne operation in history, the writer indicates the great versatility displayed by aviation. He tells of the contributions toward the success of the invasion made by the paratroops, glider-borne infantry, fighter-bomber groups, escorting and strafing fighters, etc. Special commendation is given to the pilots of the troop-carrier tugs and gliders. *Air News*, December, 1944, pages 52, 53, 78, 7 illus.

Weight Control

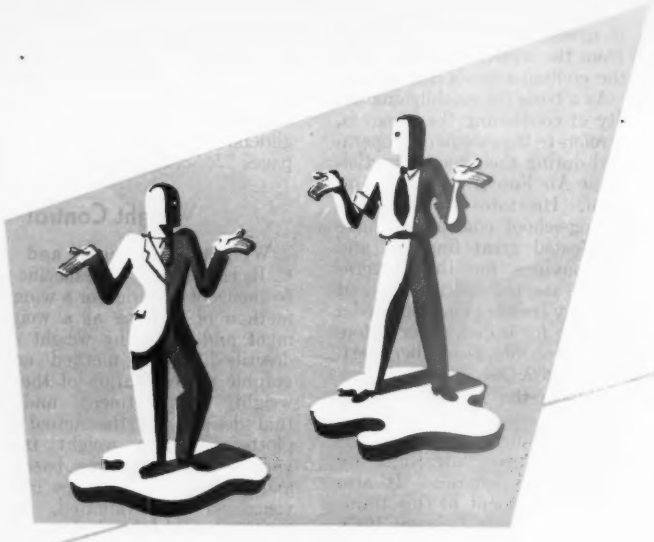
Weight Allotments and Control. C. R. Englebry. With specific reference to choice of material for a wing flange, a method of arriving at a weight allotment and exercising weight control is described. This method employs a graphic representation of the theoretic weight, the allotment, and the actual design. As the actual design is plotted, definite weight factors for various design features, based on normal bending loads as the criteria, are visualized and evaluated. Applicable to other parts of the airplane, the general principles involved in these calculations are summarized as: (1) the determination of a sound, logical weight allotment that the designer can meet while still retaining an efficient design; (2) the presentation of the material in a clear, usable form for both the designer and the weight engineer. *Aero Digest*, December 1, 1944, pages 105, 221, 222, 1 illus.

Welding

Arc Welding Safety Factors. R. F. Wyer. Safety factors in arc welding are examined from the electrical point of view. The conclusions are that arc welding is not a hazardous occupation, as judged by industrial standards, and that electric shock is a relatively infrequent cause of death. Where electrocution of the welding operator has occurred, it is claimed that one or more of three factors usually have been involved: (1) an uninsulated electrode holder; (2) wet gloves and clothing; and (3) a fall. Means of educating the welder to these dangers and of eliminating the hazards are discussed. While demonstrating the fallacy of arguments as to the difference between a.c. and d.c. with respect to shock hazards, the writer also points out the necessity for grounding the frame of the welding set; installing adequate overcurrent protection and switches in the power circuit; avoiding the possibility of getting double the normal circuit voltage between two adjacent welding circuits; keeping a close watch on accidental short circuits; and maintaining adequate safety ground connections to the frames of all welding machines. *Aero Digest*, December 15, 1944, pages 114–116, 229, 7 illus.

Impact Strength of Arc-Welded Joints in Aircraft Steel. H. O. Klinke. A report is made of an investigation conducted for the purpose of obtaining information regarding one phase of the nonstatic behavior of welds and weld boundaries in X-4130 steel as used in the aircraft industry. Several

(*Continued on page 155*)



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Source Material

For the information of readers, the following lists the periodicals, house organs, and other publications regularly received and reviewed.

The prices listed are for single issues and yearly subscriptions to recipients in the United States. Subscription prices to house organs are in many cases not available but may be obtained directly from the offices of the organization.

The frequency of publication is indicated by the following symbols: M, monthly; SM, semimonthly; BM, bimonthly; W, weekly; BW, biweekly; D, daily; Irreg., irregularly; Q, quarterly.

The AAFSATONIAN, School of Applied Tactics, Army Air Forces, Orlando, Fla., W.

Accelerator, Metropolitan Section, Society of Automotive Engineers, 29 W. 39th St., New York 18, N.Y., 10 issues per yr.

The Ace-Pursuiter, Special Service Office, Paine Field, Everett, Wash., SM.

Aero, Aero Division, Minneapolis-Honeywell Regulator Co., 2753 4th Ave. S., Minneapolis 8, Minn., M.

Aero Digest, 515 Madison Ave., New York 22, N.Y., SM, $0.50, $3.00.

The Aero Field, Francis J. Field, Ltd., Sutton Coldfield, England, 10 issues per year, 6*d*., 5*s*.

Aero News Letter, Aero Insurance Underwriters, 111 John St., New York 7, N.Y., BM.

Aero Products, 271 Madison Ave., New York 16, N.Y., M.

Aero Research Technical Notes, Aero Research, Ltd., Duxford, Cambridge, England, M.

Aero Time, Basic Flying School, Army Air Forces, Gunter Field, Ala., W.

Aerodome Abstracts, compiled by the Department of Scientific and Industrial Research and issued in collaboration with the Air Ministry, The Institution of Civil Engineers, St. George St., Westminster, London, S.W.1, M.

Aeronáutica, Avda. de Mayo 1370, Buenos Aires, M, $0.60 (pesos), $4.50 (pesos).

Aeronáutica, Clasificador F-468, Santiago de Chile, M, $6.00 (pesos), $50.00 (pesos).

Aeronautical Briefs, Aeronautical Chamber of Commerce of America, Inc., 610 Shoreham Bldg., Washington 5, D.C., M.

Aeronautical Chamber of Commerce of America, Inc., Weekly Washington Bulletin, 610 Shoreham Bldg., Washington 5, D.C., W.

Aeronautical Engineering Review, 1505 RCA Bldg. West, 30 Rockefeller Plaza, New York 20, N.Y., M, $0.30, $3.00.

Aeronautics, Tower House, Southampton St., Strand, London, W.C.2, M, 2*s*., 26*s*. 6*d*.

The Aeroplane, Bowling Green Lane, London, E.C.1, W, 1*s*., 58*s*.

The Aeroplane Spotter, Bowling Green Lane, London, E.C.1, BW, 3*d*., 8*s*. 8*d*.

Air Age Education News, Air Age Education Research, 100 E. 42d St., New York 17, N.Y., BM.

Air Base News, Army Air Base, Jackson, Miss., W.

The Air Box, Chandler-Evans Corp., So. Meriden, Conn., BM.

Air Currents, Army Air Field, Coffeyville, Kan., W.

Air Facts, 30 Rockefeller Plaza, New York 20 N.Y., M, $0.25, $3.00.

Air Force, Army Air Forces, 101 Park Ave., New York 17, N.Y., M.

The Air Line Mechanic, 155 N. Clark St., Chicago 1, Ill., M.

The Air Line Pilot, 3145 W. 63d St., Chicago 29, Ill., M.

Air Mail Magazine, A. Phillips, Newport, Monmouthshire, M, 4*d*., 5*s*.

Air News, 545 5th Ave., New York 17, N.Y., M, $0.20, $2.00.

Air Pilot and Technician, 515 Madison Avenue, New York 22, N.Y., M, $0.35, $3.00.

Air Tech, 545 5th Ave., New York 17, N.Y., M, $0.25, $2.50.

Air Trails Pictorial, 122 E. 42d St., New York 17, N.Y., M, $0.25, $2.50.

Air Transport, 330 W. 42d St., New York 18, N.Y., M, $0.50, $5.00.

Air Transportation, 10 Bridge St., New York 4, N.Y., M, $0.50, $5.00.

Air World, 241 Church St., New York 13, N.Y., BM, $0.15, $0.90.

Aircraft, 62 Flinders St., Melbourne, C.1, M, 1*s*. per issue.

Aircraft Engineering, 12 Bloomsbury Sq., London, W.C.1, M, 2*s*. 3*d*., 26*s*.

Aircraft Production, Dorset House, Stamford St., London, S.E.1, M, 2*s*. 6*d*., £1 14*s*. 6*d*.

The Aircraft Warning Volunteer, First Fighter Command, Army Air Forces, Mitchel Field, N.Y., M.

Aircrafter, American Stove Co., 1825 E. 40th St., Cleveland 3, Ohio, BW.

The AiResearcher, AiResearch Mfg. Co., Sepulveda Blvd., Los Angeles, Calif., M.

Airflow, Academy of Aeronautics, Jackson Heights, L.I., N.Y., and Casey Jones School of Aeronautics, Newark, N.J., M.

Airlanes, 340 W. 57th St., New York 19, N.Y., M, $0.25, $2.50.

Airmail Digest, Charles B. Charmatz, Sylvania, Ohio, Irreg.

Air-O-Mech, Army Air Forces, Seymour Johnson Field, N.C., W.

Airport Manager's Service Bulletin, Aero Insurance Underwriters, 111 John St., New York 7, N.Y., BM.

Airports, 1170 Broadway, New York 1, N.Y., M, $0.25, $3.00.

Airpost Journal, American Air Mail Society, Albion, Pa., M, $0.20, $2.00.

The Air-Scoop, Army Air Base, Pueblo, Colo., W.

Alamogordo Blockbuster, Army Air Base, Alamogordo, N.M., W.

Allisonews, Allison Division, General Motors Corp., Indianapolis, Ind., SM.

Aluminum and Magnesium, 133 W. 21st St., New York 11, N.Y., M, $3.00 yr.

Aluminum News Letter, Aluminum Co. of America, Pittsburgh 19, Pa., M.

AM, Army Air Field, Lincoln, Neb., W.

American Aviation, American Bldg., Washington 4, D.C., SM, $0.25, $4.00.

American Aviation Daily, American Bldg., Washington 4, D.C., D, $170.00 yr.

American Aviation Directory, American Bldg., Washington 4, D.C., semi-annually, $5.00, $7.50.

American Aviation Traffic Guide, 139 N. Clark St., Chicago 2, Ill., M, $0.50, $5.00.

American Helicopter Society, Semi-Technical Bulletin, Newfield P.O. Box 4029, Bridgeport 7, Conn., Irreg., $0.50 per issue.

The American Mercury, 570 Lexington Ave., New York 22, N.Y., M, $0.25, $3.00.

American Meteorological Society, Bulletin, Milton, Mass., M, $0.35, $3.50.

American Society for Testing Materials, Bulletin, 260 S. Broad St., Philadelphia 2, Pa., BM, $0.25, $1.50.

American Society of Mechanical Engineers, Transactions, 29 W. 39th St., New York 18, N.Y., M, $1.50, $12.00.

Anahuac, Calle 21 Núm. 500 Col. Moctezuma, México, D.F., M, $0.25 Mex., $3.00 Mex.

Army Life, Recruiting Publicity Bureau, U.S. Army, Governors Island, N.Y., M.

Army News, Bureau of Public Relations, War Dept., Washington 25, D.C., SM.

Army Ordnance, Army Ordnance Assn., 705 Mills Bldg., Washington 6, D.C., BM, $0.75, $4.50.

Astro-Jet, Glendale Rocket Society, 3262 Castera Ave., Glendale 8, Calif., 3 issues per yr., $1.00 yr.

Astronautics, American Rocket Society, 130 W. 42d St., New York, N.Y., Irreg., $3.00 yr.

Australia, Council for Aeronautics, Reports, Box 4331, G.P.O., Melbourne, Irreg.

Automotive and Aviation Industries, Chestnut & 56th Sts., Philadelphia 22, Pa., SM, $0.25, $1.00.

Automotive News, 5229 Cass Ave., Detroit 2, Mich., W, $0.15, $4.00.

Automotive War Production, Automotive Council for War Production, New Center Bldg., Detroit 2, Mich., M.

Avia, Victoria 788, Buenos Aires, M, $0.50 (*m/n*), $5.00 (*m/n*).

Aviação, Rua Uruguiana, 104, Rio de Janeiro, M, $4.00 (oruzeiros), $40.00 (cruzeiros).

Aviación, 429 H. W. Hellman Bldg., Los Angeles 13, Calif., BM, $1.00 yr.

Aviation, 330 W. 42d St., New York 18, N.Y., M, $0.50, $3.00.

Aviation and Yachting, 2816 Eaton Tower, Detroit 26, Mich., M, $0.25, $2.00.

Aviation Bulletin, The British Aviation Insurance Co. Ltd., 500 Place d'Armes, Montreal, Quebec, M.

Aviation Equipment, 1170 Broadway, New York 1, N.Y., M.

Aviation Maintenance, 205 E. 42d St., New York 17, N.Y., M, $0.50, $5.00.

Aviation News, 1357 National Press Bldg., Washington, D.C., W, $0.50, $5.00.

Aviation Progress, County Chamber of Commerce, Los Angeles, Calif., M.

Aviation Review, 31 Willcocks St., Toronto 5, Ontario, M, $0.25, $3.00.

Aviation Service Magazine, 549 W. Washington Blvd., Chicago 6, Ill., BM.

Aviation Writers Assn., Newsletter, P.O. Box 856, Grand Central Annex, New York 17, N.Y., Irreg.

Bakelite Review, Union Carbide and Carbon Corp., 30 E. 42d St., New York 17, N.Y., Q.

Ballardair, The Walter M. Ballard Corp., 331 Madison Ave., New York 17, N.Y., M.

Barksdale's Bark, Army Air Forces, Barksdale Field, La., W.

The Beach Post, Training Center No. 1, Army Air Forces, Miami Beach, Fla., W.

The Beam, Basic Training Center, Army Air Forces, Fresno, Calif., W.

The Beam, Pilot School (Advanced Single Engine), Army Air Forces, Army Air Field, Marianna, Fla., W.

The Beam, Special Service Office, Army Air Forces, Bolling Field, D.C., SM.

The Beech Log, Beech Aircraft Corp., Wichita, Kan., W.

The Bee-Hive, United Aircraft Corp., East Hartford, Conn., BM.

Bell Aircraft News, Bell Aircraft Corp., Buffalo, N.Y., W.

Bell Aircraft News, Bell Aircraft Corp., Marietta, Ga., W.

Bell Laboratories Record, 463 West St., New York 14, N.Y., M, $2.00 yr.

The Bell Ordnance News, Bell Aircraft Corp., Burlington, Vt., W.

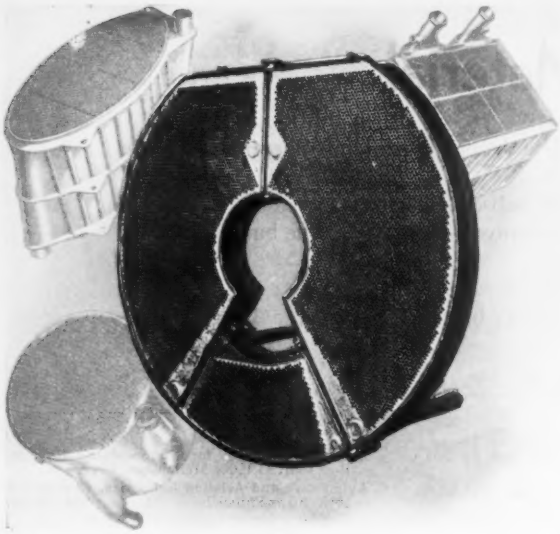
The Bellringer, Bell Aircraft Corp., 2050 Elmwood Ave., Buffalo, N.Y., M.

Bendix Communiqué, Philadelphia Div., Bendix Aviation Corp., 4700 Wissahickon Ave., Philadelphia 44, Pa., M.

Bendix Radio Engineer, Bendix Radio Div., Bendix Aviation Corp., Baltimore 4, Md., Q, $2.00 yr.

Biggstuff, Army Air Forces, Biggs Field, Tex., W.

Black Landmarks, Blackland Army Air Field, Waco, Tex., W.



HOW ALUMINUM BRAZING SIMPLIFIES ODD SHAPES

Until recently heat transfer units have been complicated by special reinforcements to give them strength in unusual shapes. At high temperatures the soft solder, which bonds copper tubes to their shells and to each other, could not stand the severe stresses set up by pressure, vibration and shear in *unusual* shapes, unless other weight-increasing supports were added.

ALUMINUM BRAZING CHANGED ALL THAT

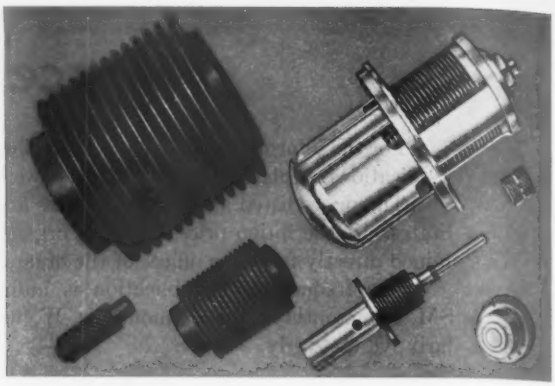
Discovery of a way to braze thin-walled aluminum tubes to aluminum header plates and shells made simply constructed odd shapes possible, for three reasons:

1. Aluminum alloy bonding material defies temperatures, pressures and strains several times higher than soft solder can stand.
2. Heat-treatable aluminum alloy tubes, header plates and shells stand temperatures and pressures that cause copper to anneal and weaken.
3. Aluminum's weight being ⅓ that of copper affords other obvious advantages to designers of products incorporating heat transfer units.

That's why USAAF designers were quick to take advantage of Clifford's discovery and put Feather-Weights to use in a number of their aircraft models.

POSTWAR PLANNING

Now war orders occupy 100% of Clifford's production . . . but inquiries and suggestions about postwar applications of all-aluminum heat-transfer units to automotive, heating, cooling and ventilating fields are welcomed. *Clifford Feather-Weights . . . Save ⅔ the weight . . . same size and shape.* Clifford Manufacturing Co., 562 E. First Street, Boston 27, Mass.



IN HYDRAULICALLY-FORMED BELLOWS

the metal has to be right

Metallic bellows can be made four ways:

1. Built up from a number of sections.
2. Mechanically spun from a welded tube.
3. Mechanically spun from a seamless tube.
4. Hydraulically formed from a seamless tube.

The first and second are as strong as their metal and joints; the third as its tool-scratched metal; the fourth as its metal only.

In hydraulically forming a bellows, no spinning tool touches its surface. It's made by forming the paper-thin walls of a metal tube between the plates of a collapsible die by means of internal hydraulic pressure. And since that pressure is much higher than any pressures it will meet in service, any bellows that survive the forming process must be metallurgically sound.

Therefore, to make hydraulic forming practical the metal from which the tube is made must be free from slag and scale inclusions . . . and the tube must be free from draw die marks, variations in wall thickness and faulty crystalline structure.

Clifford, being the first to produce hydraulically-formed bellows for industry, not only realizes the importance of metal selection, but also appreciates the critical nature of all processes involved in making bellows assemblies for controlling temperature and pressure; for sealing against pressure leakage; or for other exacting uses. *First with the Facts on Hydraulically-Formed Bellows.* Clifford Manufacturing Co., 560 E. First Street, Boston 27, Massachusetts.

CLIFFORD *Feather Weight* **OIL COOLERS AND COOLANT RADIATORS**

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Bladesman, Propeller Div., Curtiss-Wright Corp., Caldwell, N.J., Irreg.

The B-Liner, Braniff Airways, Inc., Dallas 9, Tex., M.

The Block Buster, Army Air Field, Gulfport, Kan., M.

Boeing Plane Talk, Boeing Airplane Co., Wichita, Kan., W.

Boeing Contact, Boeing Airplane Co., Wichita, Kan., M.

Boeing Magazine, Boeing Aircraft Co., Seattle, Wash., M.

The Bomb Bay, Army Air Forces, Hammer Field, Fresno, Calif., W, $2.00 yr.

Bomb Blast, Army Air Field, Childress, Tex., W.

Bombing Range High Score, Army Air Forces, Avon Park, Fla., W.

Bombs Away, Army Air Field, Victorville, Calif., SM.

The Bombsight, Advanced Flying School, Army Air Forces, Kirtland Field, N.M., W.

Booster, Pilot School (Advanced Single Engine), Army Air Forces, Napier Field, Dothan, Ala., W.

Boot Hill Marauder, Army Air Field, Dodge City, Kan., W.

The Bradley Beam, Army Air Forces, Bradley Field, Conn., W.

Breeze American, Breeze Corporations, Inc., 41 S. 6th St., Newark, N.J., M.

British Airways News Letter, British Overseas Airways Corp., Airways House, London, S.W. 1, M.

Bulaero, Cal-Aero Technical Institute, Glendale, Calif., M.

Bulletin of Technical Data for the Plywood Industry, The Resinous Products & Chemical Co., 222 W. Washington Sq., Philadelphia 5, Pa., Irreg.

Bulletin of War Medicine, British Information Services, 30 Rockefeller Plaza, New York 20, N.Y., M, $0.40, $4.65.

British Plastics, Dorset House, Stamford St., London, S.E.1, M, 1*s.* 6*d.*, 20*s.*

The Cactus, Army Air Field, Kingman, Ariz., W.

Caminos del Aire, Pan American Airways, Inc., Bolivar 18, México, D.F., M.

Canadian Air Cadet, 122 Wellington St., Ottawa, Ontario, M, $0.10, $1.00.

Canadian Aviation, 481 University Ave., Toronto 2, Ontario, M, $0.25, $2.00.

Canadian Car Journal, English Edition, Canadian Car & Foundry Co. Ltd., 621 Craig St., West, Montréal, Quebec, M.

CAP News Bulletin, Civil Air Patrol, 500 5th Ave., New York 18, N.Y., W.

The Carrier, Army Air Forces, Bowman Field, Louisville, Ky., W.

Casual Observer, Army Air Field, Lemoore, Calif., W.

Cessquire, Cessna Aircraft Co., Wichita, Kan., M.

The Chance Vought News, Chance Vought Aircraft Div., United Aircraft Corp., Stratford, Conn., SM.

Chicago Douglas Airview News, Douglas Aircraft Co., Inc., Park Ridge, Ill., W.

Chirp, The Early Birds, c/o Lt. Col. Ernest Jones, Secretary, 3401 16th St., N.W., Washington, D.C., Irreg.

Circle-News, The B. F. Goodrich Co., 500 S. Main St., Akron 11, Ohio, W.

Civil Aeronautics Journal, U.S. Govt. Printing Office, Washington 25, D.C., M, $0.05, $0.50.

Classroom Clipper, Pan American Airways, Inc., 135 E. 42d St., New York 17, N.Y., M.

Cockpit Clatter, Aircraft Owners and Pilots Assn., 1003 K St., N.W., Washington 1, D.C., BM.

Collier's, The Crowell-Collier Publishing Co., Springfield, Ohio, W, $0.10, $3.00.

The Comet, Ampco Metal, Inc., Milwaukee 4, Wis., M.

Command Post, Air Service Command, McClellan Field, Sacramento, Calif., W.

Commercial Aviation, 341 Church St., Toronto, Ontario, M, $0.25, $3.00.

Conference of International Air Traffic Operators, Bulletin, 31-32, Haymarket, London, S.W.1, M, 1*s.*, 10*s.* 6*d.*

The Connecting Link, Link Aviation Devices, Inc., Binghamton, N.Y., BM.

Construction Glues, I. F. Laucks, Inc., 911 Western Ave., Seattle, Wash., BM.

Contact, 113 W. 42d St., New York 18, N.Y., M, $0.20, $2.00.

The Continental Eagle, Continental Air Lines, Inc., Municipal Airport, Denver, Colo., M.

Convair News, Consolidated Vultee Aircraft Corp., Miami, Fla., W.

Craig Field Journal, Pilot School (Advanced Single Engine), Army Air Forces, Craig Field, Selma, Ala., W.

Current Aviation, 400 S. Front St., Columbus 15, Ohio, W, $0.80 yr.

Curtiss Fly-Leaf, Airplane Div., Curtiss-Wright Corp., Municipal Airport, Buffalo, N.Y., BM.

Curtiss Wright-er, Curtiss-Wright Corp., Lambert Field, St. Louis, Mo., W.

D and W, 100 E. 42d St., New York 17, N.Y., M, $0.30, $3.00.

Daggett Douglas Airview News, Douglas Aircraft Co., Inc., Daggett, Calif., W.

The Dalhart Bomber, Army Air Base, Dalhart, Tex., W.

Del Valle News, Bergstrom Army Air Field, Austin, Tex., W.

De Havilland Mosquito, De Havilland Aircraft of Canada, Ltd., Postal Sta. L., Toronto, Ontario, M.

The Department of State Bulletin, U.S. Govt. Printing Office, Washington 25, D.C., W, $0.10, $2.75.

Diesel Power & Diesel Transportation, 192 Lexington Ave., New York 16, N.Y., M, $0.35, $3.00.

Domestic Commerce, U.S. Govt. Printing Office, Washington 25, D.C., M, $0.10, $1.00.

Douglas Airview, Douglas Aircraft Co., Inc., Santa Monica, Calif., M.

Dow Diamond, The Dow Chemical Co., Midland, Mich., BM.

The Draftsman, 171 Madison Ave., New York 16, N.Y., M, $0.25, $3.00.

The Dragon, The Fafnir Bearing Co., New Britain, Conn., M.

Drew Field Echoes, Army Air Base, Drew Field, Tampa, Fla., W.

The Eagle, Consolidated Vultee Aircraft Corp., Ft. Worth, Tex., W.

The Eagle Eye, Eagle Pass Army Air Field, Eagle Pass, Tex., W.

Eastern Aircraftsman, Eastern Aircraft Div., General Motors Corp., Linden, N.J., M.

Edo Log, Edo Aircraft Corp., College Point, L.I., N.Y., M.

Edo Weekly Log, Edo Aircraft Corp., College Point, N.Y., W.

The Educational Focus, Bausch & Lomb Optical Co., Rochester, N.Y., Q.

El Segundo Douglas Airview News, Douglas Aircraft Co., Inc., El Segundo, Calif., W.

Electrical Communication, International Standard Electric Corp., 67 Broad St., New York, N.Y., Q, $0.75, $3.00.

Electrical Engineering, 33 W. 39th St., New York 18, N.Y., M., $1.50, $12.00.

EMCO Monthly Journal, Marks Stamp Co., Ltd., 258 College St., Toronto 2, Ontario, M, $0.50 yr.

The Engineer, 28 Essex St., Strand, London, W.C.2, W, 1*s.*, £3 3*s.*

Engineering, 35 Bedford St., Strand, London, W.C.2, W, 1*s.* 2½*d.*, £3 3*s.*

Engineering News-Record, 330 W. 42d St., New York 18, N.Y., W, $5.00 yr.

The Engineers' Digest (American Edition), 1 Madison Ave., New York 10, N.Y., M, $0.75, $7.50.

Enid Plane Facts, Enid Army Flying School, Enid, Okla., W.

Ethyl News, Ethyl Corp., 405 Lexington Ave., New York 17, N.Y., M.

The Exchangite, The National Exchange Club, 335 Superior St., Toledo 4, Ohio, M.

FAD, Fairchild Aircraft Div., Fairchild Engine & Airplane Corp., Hagerstown, Md., BW.

Fairchild News, Fairchild Camera and Instrument Corp., 88-06 Van Wyck Blvd., Jamaica 1, N.Y., M.

The Faircrafters, Fairchild Aircraft Div., Fairchild Engine & Airplane Corp., Burlington, N.C., W.

Faraday Society, Transactions, 98 Great Russell Street, London, W.C.1, M, 5*s.* per issue.

Fasteners, American Institute of Bolt, Nut, and Rivet Manufacturers, 1550 Hanna Bldg., Cleveland 15, Ohio, Q.

The Fighter Pilot, Army Air Field, Pocatello, Idaho, W.

Flagship World, American Airlines, Inc., 100 E. 42d St., New York 17, BM.

Fleetwings Arrow, Fleetwings Div., Kaiser Cargo Inc., Bristol, Pa., M.

Flexigun, Flexible Gunnery School, Army Air Forces, Ft. Myers, Fla., M.

Flight, Dorset House, Stamford St., London, S.E.1, W, 1*s.*, £3 1*s.*

Flight Control, Bendix Aviation Corp., Teterboro, N.J., M.

The Flight Pattern, Army Air Field, Douglas, Ariz., SM.

Flight Time, Basic Pilot School, Army Air Forces, Goodfellow Field, Tex., W.

Flyer, Army Air Base, Reno, Nev., W.

The Flyer, Army Air Field, Chico, Calif., W.

Flying, 540 N. Michigan Ave., Chicago 11, Ill., M, $0.35, $4.00.

Flying Aces, 67 W. 44th St., New York 18, N.Y., M, $0.15, $1.80.

The Flying M, Menasco Mfg. Co., Burbank, Calif., BW.

Flying Time, Pilot School (Basic), Army Air Forces, Pecos, Tex., W.

Flying Time, South Plains Army Air Field, Lubbock, Tex., W.

For Your Information, National Aeronautic Assn., 1025 Conn. Ave., N.W., Washington 6, D.C., W.

Foreign Commerce Weekly, U.S. Govt. Printing Office, Washington 25, D.C., W, $0.10, $4.50.

Foster Field Fighter, Army Air Forces, Foster Field, Tex., M.

The Foundation, Engineering Society of Detroit, 100 Farnsworth Ave., Detroit, Mich., M.

Franklin Facts, Aircooled Motors Corp., Liverpool Rd., Syracuse 8, N.Y., Irreg.

The Franklin Institute, Journal, Benjamin Franklin Parkway at 20th St., Philadelphia, Pa., M, $0.60, $6.00.

General Aircraft News, London Air Park, Feltham, Middlesex, England, M.

Glider Release, Laister-Kauffmann Aircraft Corp., 5660 Oakland Ave., St. Louis, Mo., M.

Gliding, 4658 Portage Rd., Kalamazoo 85, Mich., M, $0.25, $3.00.

The Globe Beam, Globe Aircraft Corp., Fort Worth 6, Tex., M.

GM Folks, General Motors Corp., Detroit, Mich., M.

The Grace Log, W. R. Grace & Co., 7 Hanover Sq., New York 5, N.Y., Q.

Gt. Brit., Aeronautical Research Committee, Reports and Memoranda, British Information Services, 30 Rockefeller Plaza, New York 20, N.Y., Irreg.

Gt. Brit., Air Ministry, Library, Additions List, The Librarian, Whitehall, London, S.W.1, M.

Gt. Brit., Air Registration Board, Notice to Licensed Aircraft Engineers and to Owners of Civil Aircraft, Brettenham House, Strand, London, W.C.2, Irreg.

Gt. Brit., Ministry of Aircraft Production, Abstracts from the Scientific and Technical Press, and Titles and References of Articles and Papers Selected from Publications (Reviewed by R.T.P. 3), Together with List of Selected Translations, Royal Aeronautical Society, 4, Hamilton Place, London, W.1, M.

Gt. Brit., Ministry of Aircraft Production, Notices (and List of New Translations Available) from the Scientific and Technical Press, The Secretary (R.T.P. 3), Millbank, London, S.W.1, M.

Gt. Brit., Ministry of Aircraft Production, Translations, The Secretary (R.T.P. 3), Millbank, London, S.W.1, M.

Gt. Brit., Stationery Office, Government Publications, British Information Services, 30 Rockefeller Plaza, New York 20, N.Y., M.

The Greenville Post, Army Air Field, Greenville, Miss., W.

The Greenwood Gremlin, Pilot School (Basic), Army Air Forces, Greenwood, Miss., W.

Grumman Plane News, Grumman Aircraft Engineering Corp., Bethpage, N.Y., W.

Guiberson Guidon, Guiberson Corp., Dallas, Tex., BW.

The Gunner's Post, Flexible Gunnery School, Army Air Forces, Harlingen, Tex., W.

Hamilton Field Takeoff, Army Air Forces, Hamilton Field, Calif., M.

The Hamilton Standard Blade, Hamilton Standard Propellers Div., United Aircraft Corp., 362 S. Main St., East Hartford, Conn., SM.

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Haul Down and Ease Off, National Assn. of American Balloon Corps Veterans, P.O. Box 2040, Wichita, Kan., BM.

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The Higgins Aircrafter, Higgins Aircraft, Inc., P.O. Box 32, New Orleans 6, La., W.

Hobart Arc Welding News, The Hobart Bros. Co., Troy, Ohio, Irreg.

Hughesnews, Hughes Aircraft Co., Florence at Teale Sts., Culver City, Calif., SM.

Inco, The International Nickel Co., Inc., 67 Wall St., New York 5, N.Y., Q.

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Institute of Radio Engineers, Proceedings, 330 W. 42d St., New York 18, N.Y., M, $1.00, $10.00.

Institute of Transport, Journal, 15 Savoy St., Victoria Embankment, London, W.C.2, Q, 2*s.* 6*d.* per issue.

The Institute of Welding, Transactions, 2, Buckingham Palace Gardens, London, S.W.1, Q, 10*s.* 6*d.* per issue.

Instrumentation, The Brown Instrument Co. Div., Minneapolis-Honeywell Regulator Co., Wayne and Roberts Aves., Philadelphia 44, Pa., BM.

Instruments, 1117 Wolfendale St., Pittsburgh 12, Pa., M, $2.00 yr.

The Intava World, International Aviation Associates, Artillery House, Artillery Row, London, S.W.1, M.

International Aviation (Foreign News Supplement to American Aviation Daily), American Building, Washington 4, D.C., W, $100.00 yr.

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The Jahco News, Jack & Heintz, Inc., Solon Rd., Bedford, Ohio, M.

Jefferson Barracks Hub, Air Forces Basic Training Center, Jefferson Barracks, Mo., W.

Journal of Applied Mechanics, 29 W. 39th St., New York 18, N.Y., Q, $1.35, $5.00.

Journal of Applied Physics, 57 E. 55th St., New York 22, M, $0.70, $7.00.

The Journal of Engineering Education, Prince and Lemon Sts., Lancaster, Pa., 10 issues per year, $0.50, $3.00.

Journal of Research of the National Bureau of Standards, U.S. Govt. Printing Office, Washington 25, D.C., M, $0.30, $3.50.

Journal of Scientific Instruments, The University, Reading, Berkshire, England, M, 3*s.* 4*d.*, 40*s.*

Journal of the Aeronautical Sciences, 1505 RCA Bldg. West, 30 Rockefeller Plaza, New York 20, N.Y., Q, $2.00, $7.00.

The Keesler Field News, Eastern Technical Training Command, Army Air Forces, Biloxi, Miss., W.

Kellett News, Kellett Aircraft Corp., 58th & Grays Ave., Philadelphia 43, Pa., SM.

Kidde Industry, Walter Kidde & Co., Inc., 140 Cedar St., New York 6, N.Y., BM.

The Kinner Log, Kinner Motors, Inc., 635 W. Colorado Blvd., Glendale 4, Calif., M.

The Kollsman Instrument Dial, Kollsman Instrument Div., The Square D Co., 80-08 45th Ave., Elmhurst, L.I., N.Y., M.

Kunststoffe, Edwards Bros., Inc., 300 John St., Ann Arbor, Mich., M, $15.00 yr.

Learavian, Lear Incorporated, Piqua, Ohio, M.

Library Bulletin of Abstracts, Universal Oil Products Co., 310 S. Michigan Ave., Chicago, Ill., W.

Light Metals, Bowling Green Lane, London, E.C.4, M, 1*s.* 6*d.*, 20*s.*

The Lockbourne Air Base News, Lockbourne Army Air Base, Columbus, Ohio, W.

List of Selected United States Government Publications, U.S. Govt. Printing Office, Washington 25, D.C., SM.

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Lockheed Log, Lockheed Aircraft Corp., Burbank, Calif., Q.

The Lockheed Star, Lockheed Aircraft Corp., Burbank, Calif., W.

Long Beach Douglas Airview News, Douglas Aircraft Co., Inc., Long Beach, Calif., W.

Lubrication, The Texas Co., 135 E. 42d St., New York 17, N.Y., M.

Luftfahrtforschung, Edwards Bros., Inc., 300 John St., Ann Arbor, Mich., M, $12.00 yr.

The Lukominique, Army Air Forces, Luke Field, Ariz, W.

Lukens Steel Co., Technical Library, Bulletin, 1940 Gillen St., Coatesville, Pa., M.

The Lycoming Star, Lycoming Div., The Aviation Corp., Williamsport, Pa., M.

McDonnell Bulletin, McDonnell Aircraft Corp., Lambert Field, St. Louis, Mo., W.

The M.A.A.F. Cowling, Marana Army Air Field, Tucson, Ariz., SM.

Machine Design, Penton Bldg., Cleveland 13, Ohio, $0.50, $6.00.

Machinery, 148 Lafayette St., New York 13, N.Y., M, $0.40, $4.00.

The March Field Beacon, Army Air Forces, March Field, Calif., W.

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Mechanical Topics, The International Nickel Co., Inc., 67 Wall St., New York 5, N.Y., M.

Mechanix Illustrated, 1501 W. Broadway, New York 18, N.Y., M, $0.15, $1.80.

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Metco News, Metallizing Engineering Co., Inc., 38-14 30th St., Long Island City 1, N.Y., BM.

Metropolitan Airmail Cover Club, Bulletin, The Malin Studios, 225 W. 46th St., New York 19, N.Y., M.

The Military Surgeon, Army Medical Museum, Washington 25, D.C., M, $0.50, $4.00.

Model Airplane News, 551 5th Ave., New York 17, N.Y., M, $0.20, $2.00.

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Monthly Weather Review, U.S. Govt. Printing Office, Washington 25, D.C., M, $0.20, $2.00.

Mundo Aeronáutico, Rivadavia 945, Buenos Aires, M, $0.30 (pesos), $4.00 (pesos).

Myśl Lotnicza, Headquarters, Polish Air Force, Chantrey House, Eccleston St., London, S.W.1, M, 1*s.* 6*d.*, 15*s.*

NAAF News, Army Air Field, Newport, Ark., SM.

The N.A.T.A. Dispatch, National Aviation Trades Assn., 214 E. Armour Blvd., Kansas City 2, Mo., 36 issues per yr.

National Aeronautics, 1025 Conn. Ave., Washington 6, D.C., M, $6.00 yr.

New Horizons, Pan American Airways, Inc., 135 E. 42d St., New York 17, N.Y., M.

New York University, Contributions from the College of Engineering, University Heights, New York 53, N.Y., Irreg.

News, Army Air Field, Presque Isle, Me., W.

News Digest, Hill and Knowlton, 350 5th Ave., New York 1, N.Y., W.

Nickel Cast Iron News, The International Nickel Co., Inc., 67 Wall St., New York 5, N.Y., M.

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North Ameri-Kansan, North American Aviation, Inc., of Kansas, Kansas City, Kan., W.

Northeast Airlines Gremlin, Northeast Airlines, Inc., 1 State St., Boston, Mass., Q.

The Northeast Airlines Up-to-the-Minute Man, Northeast Airlines, Inc., Commonwealth Airport, Boston, Mass., D.

The Northern Dispatch, Army Air Base, Great Falls, Mont., W.

The Northrop News, Northrop Aircraft, Inc., Northrop Field, Hawthorne, Calif., BW.

Notam, Army Air Base, Daniel Field, Augusta, Ga., W.

The Official Foreign Air Mail Guide, 11 W. 42d St., New York 18, N.Y., M, $1.50 yr.

The Official Guide of the Airways, 608 S. Dearborn St., Chicago 5, Ill., M, $0.50, $5.00.

Ohio State University, Engineering Experiment Station News, Columbus, Ohio, M.

Oklahoma City Douglas Airview News, Douglas Aircraft Co., Inc., Oklahoma City, Okla., W.

The ORD News, Army Air Forces Training Command, Greensboro, N.C., W.

Oscillator, Western Electric Co., 195 Broadway, New York, N.Y., Irreg.

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Pacific Aeronautical Library, Check-List, 6715 Hollywood Blvd., Los Angeles 28, Calif., Irreg.

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Pan Atlantic News, Atlantic Div., Pan American World Airways, La Guardia Field, New York, N.Y., W.

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The Pegasus, Fairchild Engine & Airplane Corp., 30 Rockefeller Plaza, New York 20, N.Y., M.

Pesco Pilot, Pesco Products Co. Div., Borg-Warner, 11610 Euclid Ave., Cleveland 6, Ohio, M.

Photogrammetric Engineering, The American Society of Photogrammetry, P.O. Box 18, Benjamin Franklin Sta., Washington, D.C., $1.50 per issue.

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Plane Talk, Consolidated Vultee Aircraft Corp., Room 3301, 350 5th Ave., New York 1, N.Y., M.

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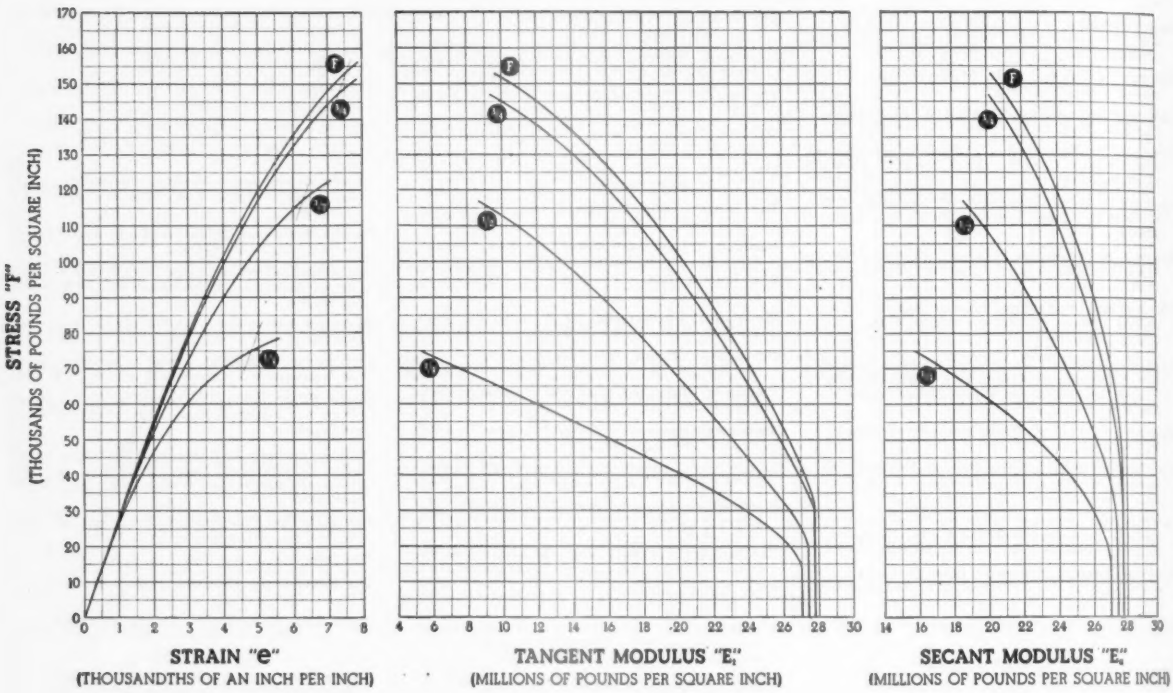
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Royal Meteorological Society, Quarterly Journal, 49, Cromwell Rd., London, S.W.7, Q, 7*s*. 6*d*. per issue.

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The Salt Tablet, Army Air Base, Wendover Field, Utah, W.

Salvo, Army Air Base, Roswell, N.M., W.

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Technical Data Digest, Air Technical Service Command, TSEAL-61, Area B, Wright Field, Ohio, M.

Technical Education News, McGraw-Hill Publishing Co., Inc., 330 W. 42d St., New York 18, N.Y., M.

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Trade-a-Plane Service, Crossville, Tenn., 3 issues per month, $0.25 yr.

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U.S., Army Air Forces, Air Technical Service Command, Translations, Wright Field, Ohio, Irreg.

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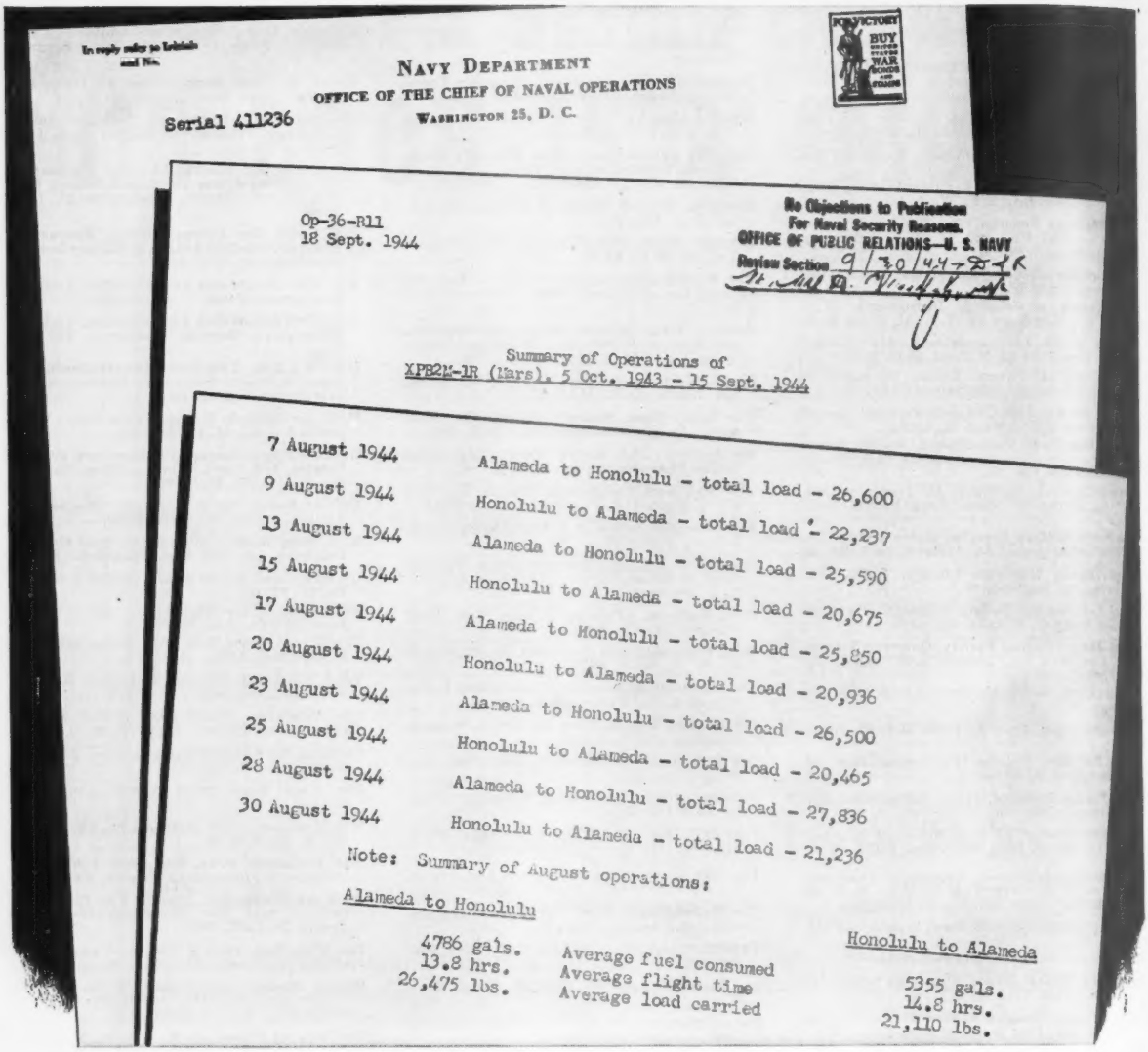
Yuma Actioneer, Army Air Field, Yuma, Ariz., W.

Zoom, Basic Flying School, Army Air Forces, Bainbridge, Ga., W.



In reply refer to Initials and No.

NAVY DEPARTMENT
OFFICE OF THE CHIEF OF NAVAL OPERATIONS
WASHINGTON 25, D. C.

Serial 411236

BUY WAR BONDS AND STAMPS

Op-36-R11
18 Sept. 1944

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For Naval Security Reasons.
OFFICE OF PUBLIC RELATIONS—U. S. NAVY
Review Section 9/30/44-20K

Summary of Operations of
XPB2M-1R (Mars), 5 Oct. 1943 - 15 Sept. 1944

7 August 1944	Alameda to Honolulu - total load - 26,600
9 August 1944	Honolulu to Alameda - total load - 22,237
13 August 1944	Alameda to Honolulu - total load - 25,590
15 August 1944	Honolulu to Alameda - total load - 20,675
17 August 1944	Alameda to Honolulu - total load - 25,850
20 August 1944	Honolulu to Alameda - total load - 20,936
23 August 1944	Alameda to Honolulu - total load - 26,500
25 August 1944	Honolulu to Alameda - total load - 20,465
28 August 1944	Alameda to Honolulu - total load - 27,836
30 August 1944	Honolulu to Alameda - total load - 21,236

Note: Summary of August operations:

Alameda to Honolulu		Honolulu to Alameda
4786 gals.	Average fuel consumed	5355 gals.
13.8 hrs.	Average flight time	14.8 hrs.
26,475 lbs.	Average load carried	21,110 lbs.

Official Navy Records Show . . .

The Martin Mars Means Ease of Maintenance!

TAKE a look at the above Navy release and you'll see why we say the Martin Mars means ease of maintenance. Only one page of the release is shown, detailing operations for August 1944. Between the 7th and the 30th of that month the Mars made 10 trips between Hawaii and the Mainland. Since then she has steadily stepped up performance and in November completed 14 flights between Hawaii and California, flying a total of 33,600 miles and carrying more than 300,000 pounds of cargo. Her current utilization is 9.7 hours per day.

This high availability of Mars flying boats will pay substantial dividends to postwar airline operators. Less time for overhaul means more time in profitable operation. This savings, along with unusually low ton-mile costs and the fact that war's end will find Mars assembly lines tooled and manned for postwar delivery at a minimum purchase price, all combine to make the most economical overocean aircraft yet built. Companies interested in detailed performance data on the Mars, write

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Government Publications

Army Air Forces

Superchargers for Pilots' Lungs Developed by ATSC. Developed by the Aero-Medical Laboratory of the A.A.F. Air Technical Service Command at Wright Field in conjunction with industry, the A-13 and A-15 masks with A-14 regulators combine the features of good demand masks, yet seal comfortably on the average face for positive pressures up to 8 to 12 in. of water.

While not a substitute for cabin pressurization, pressure oxygen breathing does foil anoxia. It gives assurance that the pilot always has 100 per cent oxygen and it permits normal men to maintain useful consciousness and carry out normal duties for one-half hour or more at 45,000 ft., and at 50,000 ft. for short emergency periods.

Normally at sea level man has 97 per cent saturation of the blood's hemoglobin. At 15,000 ft. that saturation has dropped to 83 per cent. The marginal percentage for consciousness is 70 per cent. Straight breathing of pure oxygen as in demand-type masks raises the human ceiling to approximately 40,000 ft., although a number of factors, including imperfect fitting and mask leakage caused by head movements, may lower that ceiling. Positive pressure breathing above 37,000 ft. raises the partial pressure of oxygen in the lungs, allowing the oxygen to pass into the blood stream.

The most important immediate function of pressure breathing is the use of its safety pressure of 1 to 2 in. of water between 30,000 and 40,000 ft., eliminating inboard leakage. Two to 4 in. of pressure gives airmen less fatigue and more competency on long, high missions than the present conventional system.

For breathing pure oxygen above 37,000 ft., correct pressure ranges from 2 in. at 39,000 ft. to 12 in. at 50,000 ft. A positive pressure of 8 in. can be tolerated by nearly all normal and trained individuals. One factor that may limit pressure breathing is its effect on circulation. Above 8 in. of positive pressure, the frequency of individuals suffering circulatory failure may increase. Such individuals must be eliminated from consideration for high-altitude work by preliminary flight-tests in the altitude chamber.

The demand oxygen system furnishes oxygen upon demand from low-pressure cylinders through a regulator, a diaphragm-operated flow valve that supplies the flier with the proper mixture of air and oxygen every time he inhales, shutting off when he exhales. With the pressure-demand oxygen system, oxygen flows automatically and without inhalation effort. The flow from the regulators stops when the pressure builds up in the mask at a value predetermined by a setting on the regulator dial. The exhalation effort is correspondingly increased, but is unnoticeable, especially at high altitudes, because of the low density of the oxygen in the repiratory passages.

The oxygen percentage delivered to the user increases with altitude, becoming approximately 100 per cent when the flier reaches 30,000 ft. Fully automatic, the regulators are installed as permanent fixtures at each station in the plane. When the dial is at "normal" the regulator functions as a conventional demand regulator. By turning the dial to "safety" between 30,000 and 40,000 ft., oxygen is delivered under 1 in. of water pressure. Higher pressure is obtained by turning the dial, applying torsion force on the spring and loading the diaphragm by a proportional amount.

Among the industrial concerns that made contributions to the research are the Linde Air Products Company unit of Union Carbide & Carbon Corporation, Mine Safety Appliance Company, Aero Equipment Corporation, and the Eclipse-Pioneer Division of Bendix Aviation Corporation. *Air Technical Service Command.*

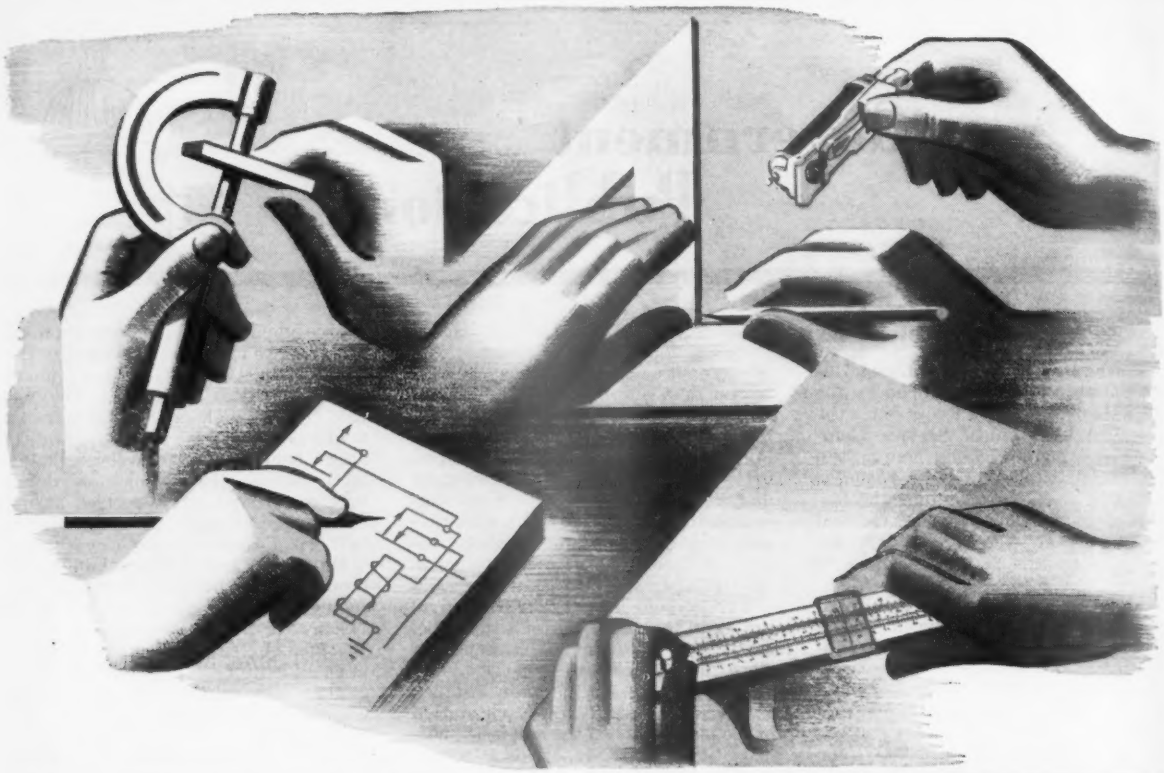
Junkers VS 11 Controllable Propeller on the Jumo 211 F and J is a translation of *Junkers VS 11 Verstell-luftschraubenanlage am Jumo 211 F and J*, dated November, 1942. This translation contains detailed instructions for assembling, installing, and operating the variable-pitch propeller equipment used on the Junkers Jumo 211F and 211J engines. The first section gives directions for assembling the propeller and the second section advises about installing the control apparatus on the engine. The third part refers to the installation of the double line.

Instructions for installing the propeller on the engine follow in the fourth section, and the connection and adjustment of the control mechanism are detailed in the fifth section. How to measure the oil pressure in the propeller-control apparatus includes advice about the correct pressure adjustments and how to test the work. The next section gives the method of operation of the mechanism, divided into three main parts which refer to cold starting, the torque-stand test, and operation in flight. Two examples show how to determine the torque-stand speed under different weather conditions. The concluding section offers advice concerning maintenance, and contains warnings about handling the propeller. Photostatic reproductions of pictures, drawings, and charts are assembled at the end of the booklet. *Translation No. 381, Air Technical Service Command.*

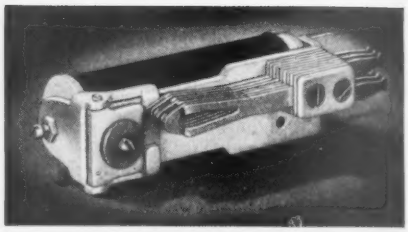
Down to Earth. From the combat reports of Eighth Air Force fighter pilots, advice is given on the "Do's and Don't's" of ground-strafing techniques. The men quoted are members of Mustang, Lightning, and Thunderbolt groups. Although the advice varies somewhat, ten basic rules as drafted by one of the pilots are outlined: (1) Before you make an attack be sure that there are no enemy planes in the vicinity. (2) Make an approach into the wind because the sound is killed. (3) Watch out for the gun positions and remember they are difficult to spot before they open fire. (4) Remember that the closer to the gun you fly the safer you are. (5) Pick out the target, give full throttle, half a ring elevation, aim carefully and steadily and open fire from about 1,000 yards. (6) At 300 yards cease fire, get as close to the ground as you dare. Forget about the target and concentrate on flying only. (7) When attacking a gun remember that you have the advantage of fire power. Concentrate on one gun at a time. Go in and kill the crew. (8) Take the initiative, strike first; don't wait for them to open fire. (9) Don't become overconfident because you are not hit in the first attack. At first the enemy gunners usually underestimate your speed, but it doesn't take them long to spot their error. (10) Never expend all your ammunition. *Air Force*, December, 1944.

New Solar Still. The Air Technical Service Command has announced the invention and development of the "Solar Still," a device for providing "ditched" air-crew men with drinking water distilled from the sea.

The floating water-still is a vinyl plastic envelope, 30 in. long with ends 12 in. in diameter. A plastic screen covered with black cellulose sponge is stretched across the middle. Through the plastic transparency of the still's envelope about 90 per cent of the sun's rays can pass; the sponge, soaked with sea water, absorbs the heat of the sun. The heat evaporates the water, which passes off as vapor, leaving the sea salt in the sponge. On the cooler envelope of the



Your New Product may need the Magic of Electrical Control



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Solar Still, the vapor condenses into fresh water, which runs down to the reservoir at the bottom of the still.

Responsible for design and development of the still are the A.A.F. Air Technical Service Command at Wright Field, the A.A.F. Proving Ground Command at Eglin Field, the Massachusetts Institute of Technology, the Gallowhur Chemical Corporation, and Higgins Industries.

The new Solar Still packs into about one-fifth the space of the older style. With the standardization of the new Solar Still, the A.A.F. plans to issue six of them for each multiplace raft, assuring each man of at least 1 pint of water per day. *Air Technical Service Command.*

The Careless Die Early. Capt. Greer Williams. This review of the duties and training of a Personal Equipment Officer indicates the importance of his work to the survival of combat flying crews. As defined by A.A.F. regulations, it is explained that a Personal Equipment Officer is a non-flying officer in each squadron, group, wing, air division, and air force responsible for the proper care and use of all personal and emergency flying equipment in each unit. *Air Force*, December, 1944.

Civil Aeronautics Administration

Review of 1944 Operations. Reviewing the year's progress in civil aviation, T. P. Wright, Administrator of Civil Aeronautics, notes that with the return of some planes to the air lines, passenger-miles flown by scheduled air carriers rose to an estimated all-time high of 2,202,000 miles. Plane loads, however, increased to more than 90 per cent of capacity, compared with 72 per cent in 1942 and 88 per cent in 1943.

As evidence of a gradual shift toward peacetime flying, the review cited the termination of the C.A.A. War Training Service Program, which had furnished the Army and Navy with 326,816 partially trained pilots from July 1, 1942, to August 5, 1944. By-products of the conclusion of this program were the sale of about 5,400 surplus aircraft, disposed of by competitive bidding with an average of eight bidders per plane; and a backlog of private business which has kept former C.A.A. flight contractors pressed for help and equipment.

During the year, C.A.A. established a center for testing Army and Navy aircraft for civil airworthiness, in order to assist manufacturers in determining what changes would be necessary to make such planes suitable for commercial use. This C.A.A. Military-Test Base is now located at Augusta, Georgia. In the field of technical research, C.A.A. announced assistance in the development of reliable and inexpensive stall-warning devices that are expected to eliminate the principal hazard of private flying; successful testing of aerial photography as a means of

choosing airport sites; a scientific fabric tester, and perfection of a new type of radio-range station that throws out a course signal in all directions.

Experiments in pilot training were carried forward under C.A.A. guidance at the University of Tennessee, Stephens College, and other institutions with the aid of magnetic wire recorders and specially installed moving picture cameras, which are used to promote uniformity in rating student-pilot performance, and to improve flight-instruction methods. Instruction of young men from the other American republics continued under C.A.A. auspices, with a group of 31 pilots in training at Purdue; 44 traffic control and communications technicians at C.A.A. Regional Headquarters, Kansas City; and 66 mechanics at Spartan School of Aeronautics, Tulsa.

Foreign operations of C.A.A. generally expanded, with A. S. Koch appointed Assistant Administrator in charge of C.A.A. foreign activities. C.A.A. missions aided pilot training in Mexico and Brazil, and in the latter country also assisted in air traffic control work. Technical advice was given to missions from the Soviet Union, Australia, United Kingdom, and many other countries. In Alaska a communications expansion program was carried out which overcame the "fade-outs" peculiar to the territory. These had rendered the system 50 per cent inoperative in the past. A new regional office was established at Honolulu to handle increasing Pacific air traffic. War emergency restrictions on flying were eased considerably outside vital defense areas, and the boundaries of those zones were narrowed greatly.

The C.A.A. during the year continued to make "winning the war" its primary purpose; it has commenced some transition-period activities; and it has planned extensively for the expansion of civil aviation in all its phases for the postwar years.

Jobs of CAA and CAB Defined; Chronology of Each Body Given. A brief statement of the functions of the Civil Aeronautics Board and of the Civil Aeronautics Administration traces the course of Federal control of aeronautics from the formation of the Bureau of Air Commerce in 1926. The distinction between the two present organizations is clearly explained, and the growth and development of the two agencies is described.

In discussing the operations of the present agencies, it is noted that the Civil Aeronautics Authority was created in 1938; in the summer of 1940 it underwent two reorganizations, as the result of which the Authority actually exists now only on paper. Its functions are exercised by its two main parts, the Civil Aeronautics Board and the Civil Aeronautics Administration.

The Civil Aeronautics Board is a separate and independent organization. It comprises a five-man panel and prescribes the Civil Air Regulations that deal with the competency of airmen, airworthiness of aircraft, and air-traffic control. The Board also issues certificates permitting persons to engage in air transportation as a business, fixes air-mail rates, and may establish maximum and minimum rates for transportation of passengers and goods. It also has the duty of investigating accidents in air transportation. In addition to these rule-making and investigative functions, the Board acts as "judge" in prosecutions brought by the Administrator of Civil Aeronautics in connection with the revocation or suspension of airman and air-carrier certificates as a result of violations of the Civil Air Regulations.

The Civil Aeronautics Administration is a part of the Department of Commerce, with an Assistant Secretary in charge, and is headed by the Administrator of Civil Aeronautics. It operates six main services as follows: Federal Airways, Airports, Safety Regulations, Information and Statistics, Foreign Operations and Aviation Training, in addition to the Washington National Airport and Standardization Center at Houston, Texas. An outline is given of each of these services. *Civil Aeronautics Journal*, November 15, 1944.

Civil Aeronautics Board

Amended Emergency Flight Rules. The Civil Aeronautics Board has amended the "Emergency Flight Rules," Section 60.95 of the Civil Air Regulations, to reduce the wartime restrictions on civilian flying. The original Emergency Flight Rules were first modified by the Civil Aeronautics Board in December, 1943. Military authorities recently approved this further modification of CAR 60.95. The amended rules provide in part as follows:

(1) Requirements have been waived for the maintenance of guards, or for leaving aircraft in an inoperative condition when unguarded. (2) The existing requirement that aircraft land only at formally designated landing places is being abandoned. Henceforth formal designation will be required only for those fields at which aircraft are regularly to be based, and occasional landings and take-offs may be made elsewhere at the pilot's discretion. (3) Owners of aircraft needing to base them at points not now regularly designated as landing areas may henceforth make application to the Administrator of Civil Aeronautics for the designation of areas which they wish to use. (4) No change is made in the requirement that

YOUR NEW CAR!

Everyone will want to look at it. Neighbors will ask you about it. Friends will want to ride in it. ★ As far as outward appearance is concerned, of course your new car will be beautiful, but won't look too *radically* different from your 1942 model—although you *can* expect some surprises. ★ ***But it will differ considerably in other ways—extremely important ways.*** ★ Its vital parts will be better than they used to be. ★ New and far more exacting standards of precision, in an industry that has grown great through precision, will make your new car a better running, better riding, more economical, longer-lived vehicle. ★ New manufacturing methods—new steels and many other new materials—will be employed in building it. ★ The motor car industry never stands still. While building aircraft engines, tanks, cars, guns, and hundreds of intricate mechanical devices for war, it is acquiring the broader engineering and production experience that will be so evident in the performance of your postwar car or truck. ★ Here at Eaton we *know* that—for we have been intimately associated with the automotive industry during both World Wars and the quarter century between.

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in eastern and western vital defense areas each individual flight of civil aircraft must be approved by the Defense Command, which approval may be obtained in most cases through the Civil Aeronautics Administration. (5) In certain congested areas, and particularly in the vital defense areas, military authorities may require establishment of local flying areas for each designated landing area, in order to avoid conflict with adjacent military activities. No flight clearance is necessary in vital defense areas when flights are confined to such local flying areas.

Australian Council for Aeronautics

Ducted Fans: Design for High Efficiency. G. N. Patterson. This report is the first of a series on the subject of ducted fans in which various aspects of the design problem are considered.

A method of design of axial flow fans for use in duct systems is developed. The momentum and vortex theories of the propeller as applied to ducted fans are reviewed and a set of conditions deduced which lead to the design of a fan of high efficiency for any given duct. These conditions show that the choice of the ratio of axial velocity to rotational velocity of the blade element is of primary importance, while so long as the ratio of lift to drag is large, it is a somewhat secondary consideration. The radial deflectors required to remove the rotation behind the fan are included as part of the general design problem.

The method eliminates the necessity for successive approximations and graphical integration of thrust and torque grading curves. It is assumed that the fan operates in conjunction with an N.P.L. type straightener. The effect of the straightener on the overall efficiency is not considered in detail. *Report ACA-7, Division of Aeronautics, Council for Scientific and Industrial Research,* July, 1944.

The Practical Significance of Notched-Bar Impact Tests. A. R. Edwards. As a result of a recommendation forwarded to the Council for Scientific and Industrial Research by the Aircraft Steels Committee of the Standards Association of Australia, it was decided to carry out an investigation of Australian aircraft steels, with special reference to the significance of notched-bar tests. Owing to the well-recognized divergence of opinion regarding the utility of the notched-bar test, it was further proposed that a study of published data on the practical value of the tests be made, to aid in deciding whether or not the insertion of notched-bar figures in Australian aircraft specifications was justified. The present review and bibliography are intended to cover that part of the project.

The main conclusions reached in consequence of this search are given at length in Section II. From these, it is apparent that the majority of writers approve of the inclusion of a notched-bar figure in specifications for steels. In particular, the test is recommended (with certain definite limitations) as an indication of "notch effect" quality, condition, and brittleness. Its value as a test of resistance to impact is generally conceded to be of secondary importance, while its relation to service conditions and other mechanical properties of materials are controversial subjects. The most serious drawbacks of the test are its extreme dependence on testing conditions and the fact that it is of no direct use to the designer. Various suggestions are put forward for increasing the information obtainable from notched-bar tests; some of these merely require an extension of the testing procedure, while others involve a basic change in method, type of specimen, or apparatus. In this second group, the slow notch-bend test finds considerable favor. *Report ACA-6, Division of Aeronautics, Council for Scientific and Industrial Research,* June, 1944.

British Information Services

The Stressing of Gyroplane Blades in Accelerated Flight. J. B. B. Owen. Reference is made to *R. & M. No. 1875,* in which it was found that blade stresses in steady flight were small, and it appeared desirable to investigate conditions of flight which might cause more severe stresses.

In the present report, the blade loads and stresses occurring immediately after a gust or sudden change of incidence are investigated by using strip theory and by neglecting, in the first place, the effect of stalling. A general method of treatment that takes stalling into account follows, and numerical examples are added. The stresses are estimated from the blade loads by the "type solution" method of *R. & M. No. 1875.*

The maximum resultant blade stresses, calculated for the accelerated flight conditions investigated, are about 30 per cent greater than those estimated for steady flight, but the resultant stresses are the sum of centrifugal and bending stresses, and the bending of a blade may be two or three times as severe in accelerated as in steady flight. The greatest bending and resultant stresses in flight occur in the middle region of the blade, and are rather less than the stresses arising during starting and taxiing on the ground. Since the latter stresses are greatest near the blade root, however, the stresses in accelerated flight are of significance in blade design.

It is found that the method of treatment may be extended to the stressing of helicopter blades. *Ministry of Aircraft Production, Aeronautical Research Committee, R. & M. No. 1878,* British Information Services, New York, $1.05.

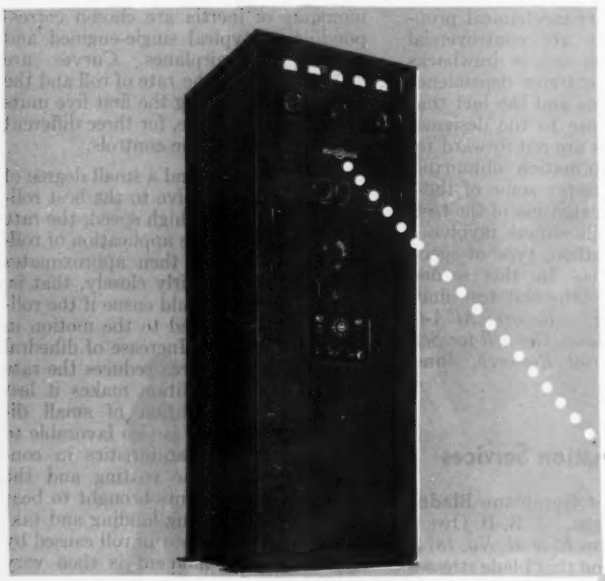
The Response of an Aeroplane to the Application of Ailerons and Rudders. Part I—Response in Roll. R. W. Gandy. The purpose of this theoretic investigation is to examine the nature of the response of an airplane in roll to the application of a given rolling couple or yawing couple, and the effect in this connection of variations in fin area and dihedral angle. Variations of forward speed and of altitude are also considered, and two sets of values of the moments of inertia are chosen corresponding to typical single-engined and twin-engined airplanes. Curves are plotted showing the rate of roll and the angle of bank during the first five units of aerodynamic time, for three different rates of applying the controls.

A large fin area and a small degree of dihedral are conducive to the best rolling properties. At high speed, the rate of roll caused by the application of rolling moment alone then approximates "simple rolling" fairly closely, that is, the motion that would ensue if the rolling were not coupled to the motion in sideslip and yaw. Increase of dihedral or decrease of fin area reduces the rate of roll, and in addition makes it less steady. The condition of small dihedral and large fin is also favorable to the best flying charateristics in connection with engine cutting and the large yawing moments brought to bear on an airplane during landing and taking-off, since the rate of roll caused by applied yawing moment is then very small. For large dihedral and small fin area, the corresponding rate of roll is much greater and has a large oscillatory component. It also follows that the poor rolling response to the application of ailerons in the latter case is made worse if the ailerons produce an adverse yawing moment. On the other hand, it is possible to counteract this and to assist the rolling power of the ailerons by using the rudder to give a yawing moment of favorable sign.

An examination is made of the relations between the derivatives, the roots of the stability equation, and the amplitudes of the various components in the response to the application of rolling moment. It is shown that the most important root, as affecting the magnitude of the response, is α_2, the small real root associated with the degree of spiral stability. As α_2 becomes less negative or more positive, the response improves: cases where the roll approximates simple rolling corresponds to very small values of α_2. At low speed, α_2 is usually positive, and the rate of roll increases indefinitely with time.

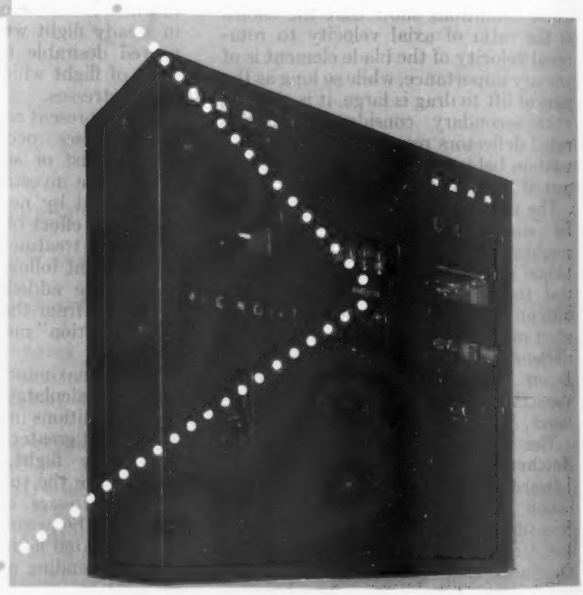
An approximation is given expressing the average rate of roll attained, attributable to the application of a given rolling moment in terms of the derivatives. This may prove useful for estimating stick forces, and the relevant formulas are given. A further report about the motion in sideslip and yaw attributable to the same control moments as are here considered, is contained in a later memorandum. *British Ministry of Aircraft Production, Aeronautical Research Committee R. & M. No. 1915,* British Information Services, New York, $2.75.

Announcing Two Highly Developed Collins Autotune* Transmitters



Collins 16F-9—Nominal power output: 300 watts phone; 500 watts CW. Frequency range: 2 to 18 mc. Ten quick-shift frequencies.

Collins 231D-13—Nominal power output: 3000 watts phone; 5000 watts CW. Frequency range: 2 to 18 mc. Ten quick-shift frequencies.



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The renowned Collins pi network matches into a wide variety of single wire or vertical antennas. The 231D-13 also matches into a 600 ohm balanced transmission line from 4 to 18 mc.

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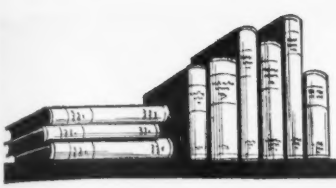

BOOKS

With the exception of aeronautical annuals and books published outside the United States, books reviewed in this section may be borrowed without charge from The Paul Kollsman Library of the Institute of the Aeronautical Sciences, 1505 RCA Building West, 30 Rockefeller Plaza, New York 20, N. Y.

Air Transport and Civil Aviation, 1944–1945

Advisory Editor, The Rt. Hon. Lord Brabazon of Tara

Contents: Appraisals of Air Transport; Technical Articles; Air Transport Legislation and Policy; Official Directories; Air Transport Committees; Statements on Policy and Work; Air Transport Companies of the World; Airline Routes of the World; Airports; Organisations Interested in Air Transport and Civil Aviation; Statistics and Tables; Transport Aeroplanes; Books, Periodicals, and Films Dealing with Aviation; Who's Who in Air Transport and Civil Aviation.

The second edition of this annual covers 1944 and gives a broad view of the present status of world air transport and of the many questions that are being discussed relating to this pressing development.

In the first section the leaders of various branches of aeronautics in many countries present their opinions and conclusions in a group of articles, a feature that makes this annual broader in scope than the usual nationalistic presentation. Specialists in technical fields write of the progress made in design and materials.

A section of the book is given to a summary of the reports of air transport committees. One of the most valuable parts of the book gives brief histories of the leading transport companies of the world. Following this are directories of air transport companies of the world arranged alphabetically and by countries, a list of air-line routes of the world, the world's principal airports, statistical information concerning air transport and other related activities. Brief descriptions are given of various transport airplane types, as well as a list of aeronautical books, periodicals, and films. A short "Who's Who" in British air transport and civil aviation brings the book to a close.

The broad coverage of the annual makes it a useful source of information regarding all phases of civil aviation. Todd Publishing Company, Ltd., London, 1944; 311 pages, 2*s*.

Pioneering the Helicopter

Charles Lester Morris

Contents: In Retrospect; The VS-300 Is Born; Adolescence; On the Past Is Built the Future; Records for America; I Am Fledged; New Model—New Horizon; Performance Demonstrated; History in the Making; Mission Completed; The XR-4 Grows Up; Work and Play; Prophecy and Warning.

No one in this country has had greater experience in piloting the pioneer models of the helicopter than the author of this timely book. With a background of 10 years as Commissioner of Aeronautics for the state of Connecticut, he joined Igor Sikorsky in the development of his helicopter. Since then he has become one of the noted pilots of rotating-wing aircraft and has established many records.

In this book he tells of the problems that were encountered in the development of Vought Sikorsky types and how each was solved to give them a practical use for military, naval, and peacetime purposes.

The text reflects a realistic study rather than overly optimistic assertions. Personal experiences that cover practically the span of the flight-testing are related. Mr. Sikorsky, in an introduction, writes that Mr. Morris quickly learned to fly the helicopter, then surpassed Sikorsky's flying skill, and up to the time of writing the book had accumulated more flying hours in these machines than any other man.

At the end of the book conservative prophecies and some warnings are given concerning the practical applications of the helicopter, the scope of production and market prospects, and other factors. Mr. Morris recently became Director of Field Operations of Bendix Helicopter, Inc. McGraw-Hill Book Company, Inc., New York, 1945; 161 pages, $2.75.

Civil Aviation

Michael Young

Contents: The First Thirty-Seven Years; Development in Air Transport; The Forcing House of War; Aviation After the War; Britain's Experience; Aviation and Politics; What Must We Decide?; A Target.

Following a review of the history of civil aviation in Great Britain, this booklet traces the general development of air transport and surveys the problems of postwar development.

Britain's experience is studied with critical analysis. The question of "chosen instrument" or general competition is considered. The conclusions of the author are that there should be a World Airways company organized to operate all air lines in Europe and the Far East as well as the great international trunk lines over the Atlantic and the Pacific oceans.

He recommends an International Board of Air Navigation to regulate all routes other than those covered by the proposed World Airways.

British Overseas Airways Corporation would, under the plan suggested, continue as the chosen instrument for the operation of all Britain's overseas air services.

Finally, it is proposed that civil aviation be transferred from the Air Ministry to the Ministry of Transport. The Pilot Press Ltd., London, 1944; 65 pages, 4*s*. 6*d*.

Aero Digest Blue Book 1945

Frank Tichenor and *Aero Digest* have rendered an invaluable service to everyone in the aircraft industry, the aeronautical profession, and the nation's air forces by publishing a reference manual that is unusual in its scope and detailed compilation. Its well-arranged directories and complete indexes make for easy reference.

A directory such as this has more than utilitarian value. It shows how well organized and how vast the aviation field has become in the last few years.

Not so many years ago it was possible for one person to know almost everyone engaged in an executive position in the aircraft industry. A glance at the 779 pages in this yearbook will indicate how essential it is now for everyone to have such a directory within reach.

The book is distributed free with the compliments of Mr. Tichenor and the thousands who will find the book helpful will join with the AERONAUTICAL ENGINEERING REVIEW in giving Mr. Tichenor that appreciation earned by a genuinely helpful contribution to those engaged in aeronautical endeavors. Aeronautical Digest Publishing Corporation, New York, 1944; 779 pages.

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No ordinary metal can curb the tremendous landing momentum of the world's mightiest warplane ... the B-29.

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Close-up view of a section cut from a typical Centrifuse brake drum, showing fusion between steel and alloy iron. Besides resistance to wear and to heat-checking, other advantages include minimum scrap loss and maximum soundness in the product. Range of sizes run from 8" to 20" diameter. Centrifugal Fusing Company alone has produced over 4,000,000 pounds of such castings.

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American Warplanes in Action

Sydney E. Veale

Contents: The Operational Qualities of American Warplanes; American Warplanes in Action; The American Air Forces; The U.S. Aircraft Industry; Some Notable Types.

This English analysis of the history and production of military and naval aircraft in the United States gives in text and pictures an overall summary of our air war effort.

After explaining the operational qualities of various types, a brief history of these planes in action is given. A short review of the evolution of our air forces from their small beginnings in the Signal Corps, a brief sketch of the American aircraft industry, and a survey of some of the aircraft that have made notable successes give the text a broad coverage.

The exceptionally well-chosen illustrations and a table giving the characteristics of all our military and naval aircraft not on the restricted list make the book one of the most complete studies that has appeared of our great effort in aircraft production. The Pilot Press, London, 1944; 48 pages, 5*s*.

Young America's Aviation Annual 1945

Edited by David C. Cooke

Contents: Airpower; The Army Air Forces; Naval Aeronautics; The B-29 Superfortress; Naval Air Transport Service; Flying Health; The Manufacturing Industry.

During the past 5 years Mr. Cooke has written a carefully prepared record for each preceding year's progress in aviation. The experience and training of the author are reflected in his observations, which are clear to young readers as well as to their elders.

The author has divided the text into military, naval, and industrial divisions, and he treats the great progress of the year from a broad point of view. The aeronautical profession is fortunate in having competent writers who are able to give time to the preparation of such historical reviews which will be of inestimable value to future historians.

The illustrations in the annual are in themselves a panorama of the advances made during the year. They were obviously selected with great care and have been reproduced with excellent captions. Robert M. McBride & Company, New York, 1944; 222 pages, $2.50.

Rockets, Dynamators, Jet Motors

A. L. Murphy

Contents: Atmospheric Jets; Ejector; Electric; Engine; Hydraulic; Injector; Motorized; Rocket; Thermal; Turbines; Combinational; Control by Jets; Dynamator and Combinational; Jet Vehicles, Craft, Means for Launching; Landings; Craft and Vehicles; Fuels and Supply Methods; General Comment; Models; Dynamator Explanations; Random Features; Sea Level.

This manual, set in the question-and-answer form, covers the fields of rocket and jet propulsion. It explains the use of jets for many purposes: electric, hydraulic, rocket, thermal, turbine, etc.

The author has coined a new word, "dynamator," to express arrangements or designs of a converter or applicator that uses jets for any purpose of control or propulsion. The many applications of jets and rockets to land, sea, and air vehicles are described. Questions about fuels used and the operation of these reaction-powered craft are answered.

In a subject as new as this there are many controversial opinions. The author dares to express positive ideas, some of which are certain to be questioned, but which will undoubtedly stimulate discussion. Wetzel Publishing Company, Inc., Los Angeles, 1944; 169 pages, $2.50.

Aircraft Vibration and Flutter

C. R. Freberg and E. N. Kemler

Contents; Elementary Vibrating Systems; Isolation and Soundproofing; Systems with Several Degrees of Freedom; Beams and Wings; Flutter and Buffeting; Flexure-Torsion Binary Flutter; Flutter with Control Surfaces; Control-Surface Balancing and Flutter Prevention; Rotating-Wing Aircraft.

The elementary and general phases of vibration and flutter as applied to the airplane structure and its parts are dealt with in this book. The methods described can be applied by an engineer without the background of advanced mathematics. Emphasis has been placed on the solution of problems and on physical interpretation and application. Theory has been given secondary consideration.

The authors' aim has been to provide a book that will meet the needs of the average young engineer in the aircraft industry. The application of general principles to simple airplane vibration problems is dealt with in the first part of the book. Vibration problems that involve aerodynamic forces are discussed in the latter part of the book. John Wiley & Sons, Inc., New York, 1944; 214 pages, $3.00.

The Aircraft Annual 1945

Edited by David C. Cooke

Contents: War in the Air; The U.S. Army Air Forces; The U.S. Navy Air Service; Late Military Developments; The Army Air Forces at War; Civil Airlines Extend Aid; What's New in the Air; Miscellaneous Activities; The Manufacturing Industry.

The second edition of the record of aeronautical progress and development, both in the war and in civil aviation, is a clearly written account of the author's observations of the intense activity of the past year. About half the book is given to the war in the air, the remainder to phases of civil and industrial aviation.

After a general review of the year's warfare in the air, the specific accomplishments of the Army Air Forces and the Naval Air Service are traced. New technical developments in military and commercial aircraft, as well as advances in manufacturing techniques, are described.

The book is well organized and the various chapters adequately cover each development. For a general picture of the utility of the airplane in 1944, the annual will be a useful addition to the historical record of aeronautics. Robert M. McBride & Company, New York, 1944; 288 pages, $3.00.

Our Flying Navy

Text prepared with Assistance of the Office of the Deputy Chief of Naval Operations (Air)

Contents: History of Naval Aviation; The Flat Tops; Lighter Than Air; Sea-Air Battles of World War II; Waves of the Sea; The Men Who Fly the Sea; Naval Aviation Today.

As this book has the endorsement of Secretary Forrestal and Rear-Admiral Radford, the text and reproductions of paintings showing operations of airmen of the Navy may be considered official.

The historical section of the book traces briefly the Navy's part in the development of the airplane, lighter-than-air craft, and the aircraft carrier. Descriptions of sea-air battles of World War II to date, the story of the Women's Reserve of the Naval Reserve, a human interest account of the progressive training of naval airmen, and a general sketch of naval aircraft give a broad idea of naval aviation as it is today.

The pictorial section is in color. Reproduced are paintings by artists who have done their work from personal observation. This is probably the finest collection of naval aviation prints that has appeared and will give the public a better idea of the life of the naval airman on shore and in combat than can be found elsewhere. The Macmillan Company, New York, 1944; 97 pages and picture section, $3.25.

Manual of Aircraft Layout

Rudolph Faltus and Charles Steinmetz

Contents: The Structural Aircraft Mechanic; Aircraft Blueprint Reading; Aircraft Layout Tools and Instruments; Laying Out the Job, Templates; Template Layout 1. Plates and Gussets; Template Layout 2. Right-Angle Bends; Template Layout 3. Open and Closed Bends; Simple Trigonometry in Template Layout; Geometrical Template Layout; Machines and Hand Tools in Template Making; Charts and Tables.

Written to serve as a textbook, as a manual, and as a reference book, this volume on aircraft layout is intended for use in both factories and schools. To impart concrete information, the discussion is focused on original drawings. The graduated exercises are selected from instructional experiments in developing industrial skills. The book gives instruction in blueprint reading, the laying out of jobs, template development and uses, and such accessory topics as layout tools, machine and hand tools, and the elements of necessary mathematics. Charts and tables commonly required in the fabrication of aircraft parts are provided. John Wiley & Sons, Inc., New York, 1944; 240 pages, $3.00.

Parachute Technician

Charles A. Zweng

Contents: Parachute Construction; The Harness; The Canopy; The Pack; Maintenance; Method of Inspection; Pack-carrier Assembly Inspection; Inspection of Harness; Operation of the Parachute; The Jump; The Descent; The Landing; Parachute Use—General Rules; Packing, C.A.R.; Jumping, C.A.R.; Material and Tests, C.A.R.; Parachute Technician Certificates, C.A.R.; Parachute Loft Certificates, C.A.E.; Tensile Strength of Materials; Packing Instructions, (Irvin Air Chute); Adjusting the Harness; Pioneer—Special Instructions; Typical Examinations, C.A.R., Packing, Inspection and Maintenance; General Review.

A manual of instruction regarding parachutes, written especially for applicants seeking Parachute Technician ratings and for ground instructors who desire an instruction manual meeting the requirements of the Civil Aeronautics Administration for these ratings. Included are regulations governing the issuance of the Parachute Technician Certificate and the respective ratings. There are sections devoted to modern parachute construction, the canopy, the parachute pack, parachute operation, maintenance, inspection, and packing.

The last section of the text contains typical "multiple choice" examinations planned to meet the requirements of the written test. An appendix contains a nomenclature of parachutes. Pan American Navigation Service, N. Hollywood, Calif., 1944; 111 pages, $3.00.

Vibration Analysis

N. O. Myklestad

Contents: Fundamentals; Undamped Vibrations of Systems of One Degree of Freedom; Damped Vibrations of Systems of One Degree of Freedom; Vibrations of Systems with More than One Degree of Freedom; Applications to Important Practical Problems.

In writing this book the author's purpose has been to provide a text for courses in vibration analysis, and also to furnish the reader with the best methods of solving practical vibration problems occurring in modern engineering.

The first five chapters are devoted to helping the reader understand the various phases of the phenomenon of vibration. In the concluding chapter the author gives simple tabular methods of solving most of the important vibration problems that arise in engineering and that involve systems of more than one degree of freedom. All sections of the book are illustrated by examples, and the sections intended primarily as a text are accompanied by problems and questions. Answers to most of the problems are given. McGraw-Hill Book Company, Inc., New York, 1944; 303 pages, $3.50.

Care and Use of Hand Tools

Raymond R. Toliver

Contents: Vises; Hammers; Cold Chisels; Files; Screwdrivers; Hacksaws; Pliers and Nippers; Wrenches; Torque Wrenches; Machine Screw Taps; Drilling; General Reaming Practices; Measuring Tools; Micrometers; Demonstration and Discussion Guide.

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Covers the Basic Principles of a Large Subject in a Small Space

This compact volume covers the principles of aircraft vibration in very easy-to-understand, simple language, with a minimum of advanced mathematics. An extremely practical book which concentrates on the more elementary phases of the subject without delving into the involved theories of aerodynamic forces. Gives you all the necessary information for solving most of the vibration problems that arise from aerodynamic as well as mechanical sources.

Fully illustrated with clear line diagrams, this book is ideal for mechanical and aeronautical engineers, aircraft maintenance men, Army, Navy and civilian pilots and all others whose livelihood has to do with aviation.

193 Pages Illustrated $3.00

CONTENTS

Introduction; Elementary Vibrating Systems; Isolation and Soundproofing; Systems with Several Degrees of Freedom; Beams and Wings; Flutter and Buffeting; Flexure-Torsion Binary Flutter; Flutter with Control-Surfaces; Control-Surface Balancing and Flutter Prevention; Rotating-Wing Aircraft; Bibliography.

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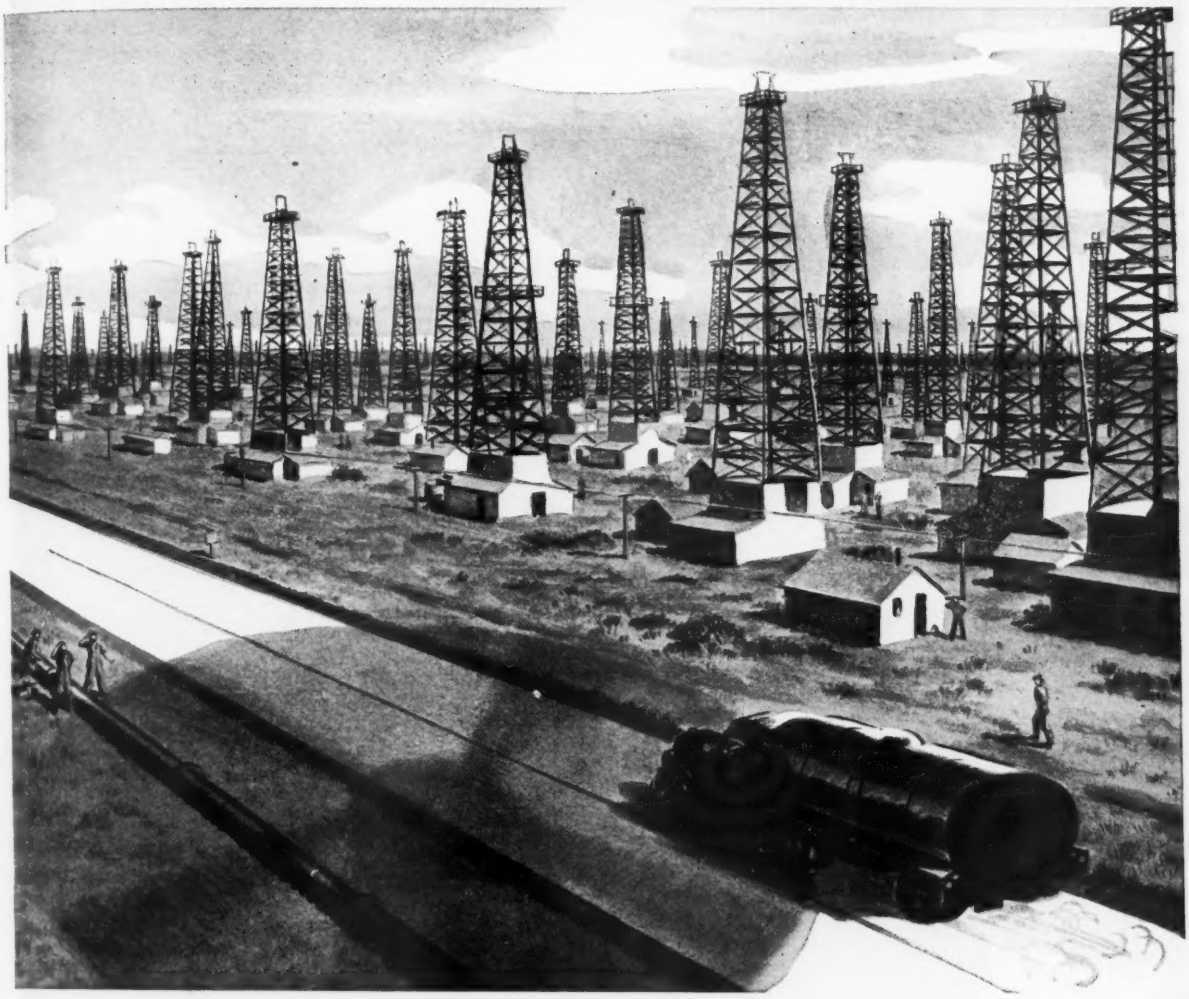

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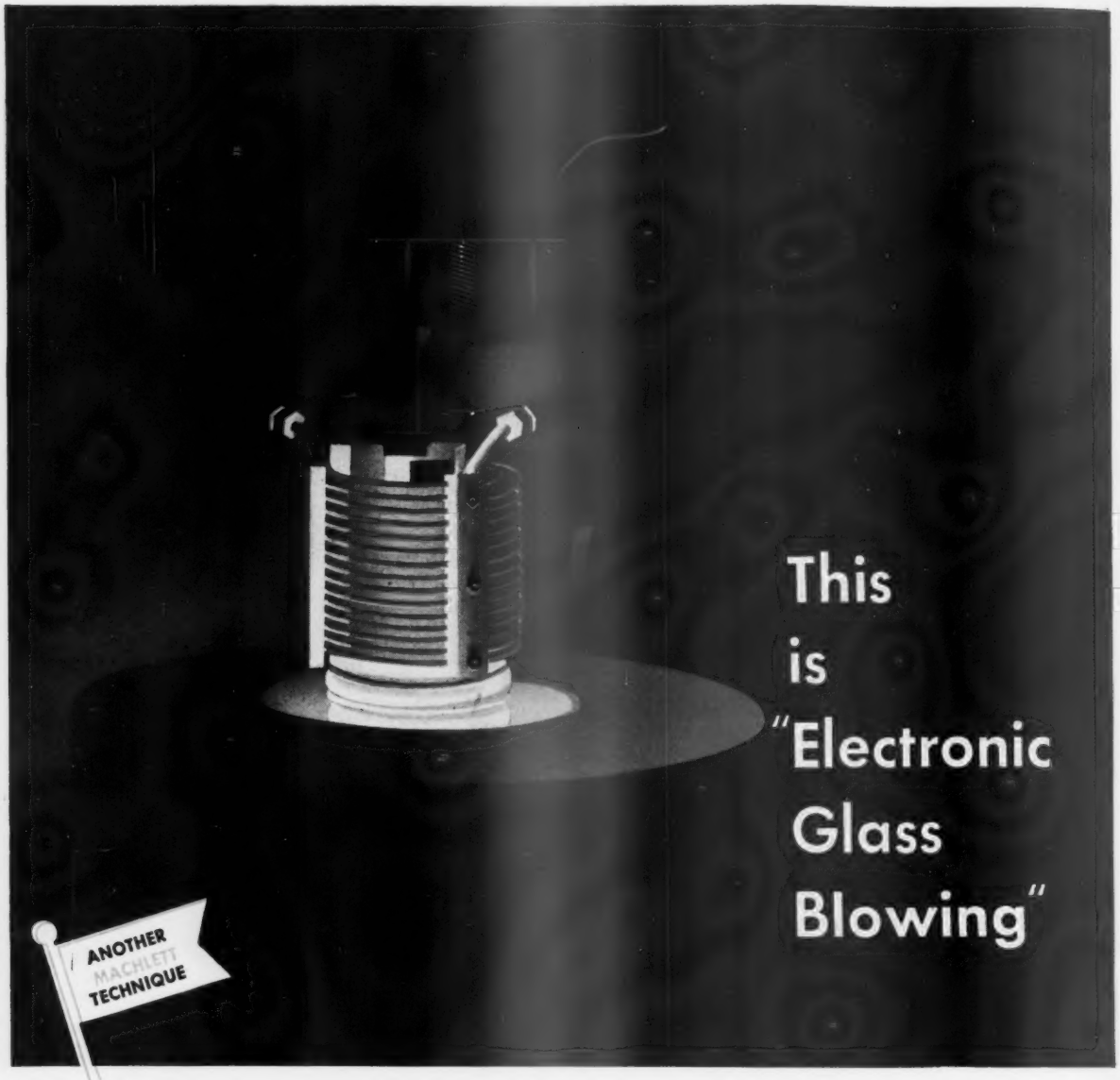
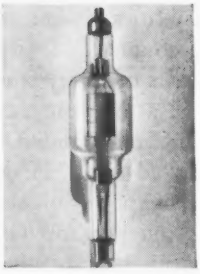


A group of scientists recently designed a vacuum tube of great potential usefulness. It required a long, air-tight column made with a large number of alternate rings of glass and metal, and conventional methods of glass blowing offered no promise whatever. When asked what could be done, Machlett cast aside precedent, as it often does, and devised a way of producing the "impossible" column.

Here it is. On top of a ring of glass is placed a ring of one of the special alloys that have the property of fusing with glass. Another glass ring goes on top of this. A high-frequency induction coil is lowered over this sandwich, heating the metal so hot that the glass is softened to exactly the right degree for formation of a perfect fused joint, when supplemented by other glass-working techniques. Another sandwich on top of the first is treated in the same manner, and so the column grows.

Induction heating often makes the impossible practical; this is an example of that, and of Machlett's willingness to tackle baffling problems. If you have a vacuum tube problem (X-ray or radio) see Machlett. Skill of this type stands back of every Machlett X-ray and radio tube, including the one illustrated above . . . Machlett Laboratories, Inc., Springdale, Connecticut.



ML-100, high-voltage industrial rectifier.

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shops, this elementary manual was prepared originally for the training of new employees in a bomber plant. Its inclusion of general information about basic hand tools in addition to data bearing direct reference to actual shop operations makes the manual suitable for shop classes in high schools and manual-training institutions as well as preproduction industrial training classes.

The study takes into account the construction, functions, applications, types, sizes, and care of vises, hammers, cold chisels, files, screw drivers, hacksaws, pliers and nippers, wrenches, torque wrenches, machine-screw taps, drills, reamers, measuring tools, and micrometers. Besides advising on ways of most efficiently using each tool, it also tells about safety precautions necessary in the employment of each. A demonstration and discussion guide is appended to assist instructors in testing pupils' knowledge of the material contained in the book. John Wiley & Sons, Inc., New York, 1944; 93 pages, $1.25.

Descriptive Meteorology

Hurd C. Willett

Contents: The Composition and the Vertical Extent of the Atmosphere; Adiabatic Processes and the Vertical Stability of the Atmosphere; The Heat Balance of the Atmosphere and the Explanation of the Observed Temperature Distribution; Evaporation and Condensation in the Atmosphere; Wind Velocity in the Atmosphere; The General Circulation of the Earth's Atmosphere; The Secondary Circulations of the Thermally Direct Type; Air Mass Characteristics; Secondary Circulation of the Dynamic Type; The Tertiary Circulations; The Synoptic Representation of Current Weather and the Forecasting of Future Weather.

This textbook of descriptive meteorology was written for use in a third- or fourth-year college course. It is intended for students who are familiar with general physics and with mathematics as far as elementary calculus.

The author's aim has been to provide the student with a basic understanding of the weather processes as they are observed in the atmosphere. Emphasis is placed on the organization and the continuity of the presentation of the subject rather than on completeness. Discussion of theoretic principles is kept to the minimum amount consistent with a logical explanation and a systematic description of the meteorologic phenomena as they are observed. Academic Press, Inc., New York, 1944; 310 pages, $4.00.

Climatology

Bernhard Haurwitz and James M. Austin

Contents: Part A, General Climatology: Solar Radiation and Terrestrial Heat Balance; Temperature; Wind and Pressure; Hydrometeors; Air Masses, Fronts, Cyclones, and Anticyclones; Climatic Zones and Types; Description of the Climatic Types; Microclimatology; Part B, Regional Climatology: North and Central America; South America; Europe (Excluding Russia); Asia (Including Russia); Africa; Australia and New Zealand; Arctic and Antarctic; Oceanic Regions.

Because this introduction to climatology has been written especially for students of meteorology, the authors have stressed the physical causes of climate and of the variations of the climatic elements in space and time. It is assumed that the reader is familiar with the basic concepts of meteorology and the description of the various climates is given in meteorologic language, emphasis being placed on the interpretation in terms of dynamics of the atmosphere, of air-mass types, and of frontal activity. It is stated that much of the material in this text has been presented to aviation cadets during a course on climatology at the Massachusetts Institute of Technology. McGraw-Hill Book Company, Inc., New York, 1944; 410 pages, $4.50.

Manual of Photogrammetry

Edited by P. G. McCurdy, L. A. Woodward, J. I. Davidson, R. M. Wilson, and R. E. Ask

Contents: Principles of Surveying; Photogrammetric Optics; Cameras; Photographic Materials and Laboratory Technique; Geometric Characteristics; Stereoscopy; Interpretation; Radial Plotting Methods; Photographic Mosaics; Stereoscopic Mapping Methods; Analytical Computations; Mapping from Oblique Photographs; Field Inspection and Completion; Miscellaneous Application; Training and Education; Nomenclature and Definitions.

This is a preliminary edition of a manual describing aerial photogrammetric methods, equipment, and procedures, sponsored by the American Society of Photogrammetry. It is intended to serve as a text for all those interested in aerial photogrammetry.

Emphasis is given to the peacetime applications of the work and its potential contribution to the progress of the nation in its internal and external relations. Pitman Publishing Corporation, New York, 1944; 841 pages, $8.50.

Aircraft Mechanical Drawing

D. J. Davis and C. H. Goen

Contents: Introduction to Mechanical Drawing; Lettering; Geometry in Drawing; Orthographic Projection; Sections and Auxiliary Views; Dimensions; Mathematics in Drawing; Representing Special Parts and Processes; Descriptive Geometry.

The subject matter of this book is confined to the essential principles and skills required for a thorough knowledge of practical aircraft drawing. It is intended for students without previous training in mechanical drawing. The subject matter is presented by means of discussions, explanatory exercises, and applied drawing problems; the latter develop manual skill and comprehension of the fundamentals of drafting simultaneously.

It is intended that study should be supervised by the instructor and from time to time supplemented by demonstrations of difficult points and by discussions of related general subjects, to familiarize the student with the work done in the engineering department and with the basic principles of mechanical design and construction. The materials used, the problems assigned, and the method of presentation conform as nearly as possible to the work encountered daily by those engaged in the preparation of productive engineering drawings.

Special attention is given to the latest design practices and advanced manufacturing methods in the aircraft industry. No attempt is made to cover the entire theoretic field of orthographic projection and of plane and descriptive geometry. McGraw-Hill Book Company, Inc., New York, 1944; 245 pages, $2.50.

Production Engineering in the Aircraft Industry

A. B. Berghell

Contents: Time Standards; General Principles of the Application of Time Standards; Application of Time Standards to Fabricating and Machine Operations; General Principles of Work Simplification and Suggestion Systems; Operational Sequences, Instruction Cards, and Organization of Work in Major Assembly, Subassembly, and Fabricating; Material Saving; Determination of Direct Labor Costs and Their Presentation Through Statistical Reports and Graphs; Control of Direct Labor Hours and Costs Through Cumulative Total Graphs on Arithmetic Paper and Moving Averages; Ratio or Semilogarithmic and Log-log Graphs; Ship Loading and Contract Budgeting; Learning Curves; Relations with Management and Shop.

This book on aircraft production engineering is based on the experience of of the author in teaching production engineering and aircraft statistics under the Engineering, Science, and Management War Training programs at the University of Southern California and the University of California at Los Angeles. Considerable emphasis is placed on learning curves for use in forecasting and controlling costs. These curves can be applied in practice, using graphic methods and with slight use of mathematics.

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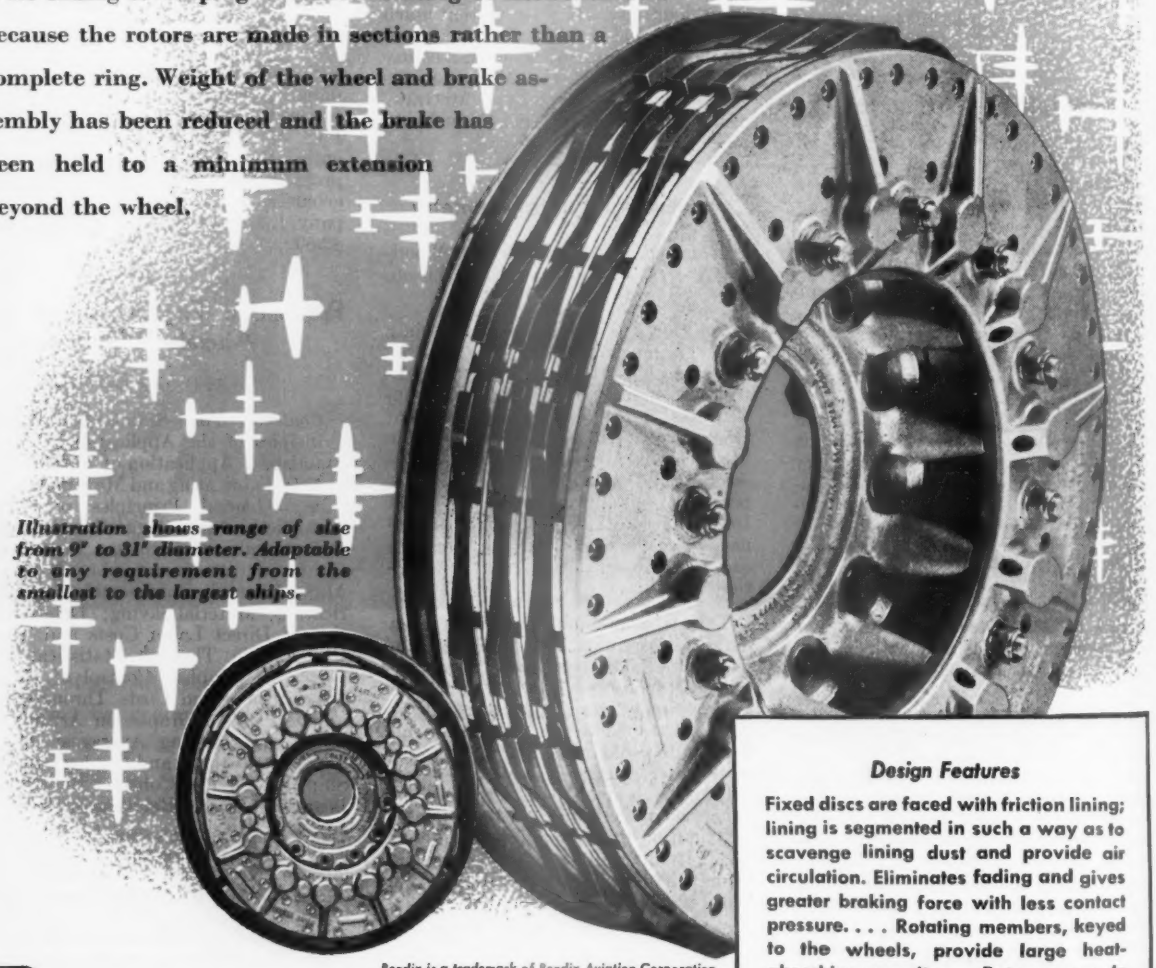

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Fixed discs are faced with friction lining; lining is segmented in such a way as to scavenge lining dust and provide air circulation. Eliminates fading and gives greater braking force with less contact pressure. . . . Rotating members, keyed to the wheels, provide large heat-absorbing capacity. . . . Rotors are made in segments instead of a continuous ring; this allows for heat expansion without warping or cracking.

Bendix Landing Gear—Bendix Pneudraulic Shock Struts—Bendix Airplane Wheels—Airplane Brakes—Hydraulic Master Cylinders and Power Brake Valves make up the list of Bendix Landing Gear Equipment

and for sub- and major assemblies for adequate control during the course of manufacturing operations, emphasis is placed on the development of reliable standards and methods of utilizing these standards in controlling production through the determination of the courses of variancies from standards. McGraw-Hill Book Company, Inc., New York, 1944; 307 pages, $3.00.

Book Notes

Ace Air Reporter, by Harry Harper; John Gifford Limited, London, 1943; 151 pages, 8*s*. 6*d*.

Harry Harper was the first of Britain's air correspondents and as such saw the development of the airplane in Europe from the viewpoint of personal observation.

His book of reminiscences is a record of aviation from its beginning through the first years of the present war. He confines his book to what he has seen and gives his opinions regarding many of the pioneer airmen. His intimate acquaintance with these men gives his book a value that can only come from personal contact.

No one will read this story of these daring and courageous men who braved ridicule and engaged in hazardous experimentation without having a greater respect and admiration for those who brought flying to its present great place in world affairs. Historians will find this to be one of the rare books having keen insight into the underlying problems that had to be solved before the airplane was accepted as a practical instrument of war and peace.

No Bombs at All, by C. H. Ward-Jackson; Sylvan Press, London, 1944; 123 pages, 8*s*. 6*d*.

At a time when books have to be published under wartime regulations, it is all the more interesting to receive an English book that is an excellent example of bookmaking as a fine art. The paper, typography, and printing are reminders of prewar perfection. The woodcuts used as illustrations are splendid examples of the wood engraver's skill and artistry.

The text is a series of short stories and verse about the Royal Air Force. They are of the human-interest type rather than tales of adventure, and they convey an impression of the daily routine and common tasks at an air station.

Air Affairs, edited by Ronald Walker; P. S. King and Staples Limited, London, 1943; 80 pages, 2*s*. 6*d*.

The various opinions of English groups on the subject of postwar civil air transport are given in this book. For background material the report on civil aviation prepared by the U.S. Office of War Information is reprinted. This is probably presented as a challenge to a greater effort in this field in Britain.

The pamphlet contains the reports of the independent committee headed by Capt. A. G. Lamplugh, the memorandum by the Society of British Aircraft Constructors reflecting their views, a statement of the case for shipowners by the General Council of British Shipping, and a study by four members of Parliament of the problem of postwar air transport. These, together with several other articles, give a broad overall picture of public opinion in England previous to the recent International Civil Aviation Conference in Chicago.

Flight to Everywhere, by Ivan Dmitri; McGraw-Hill Book Company, Inc., New York, 1944; 240 pages, $6.00.

This book is a collection of famous photographer's pictures, taken on a trip with the Air Transport Command from New York to China and a return trip via North Africa, Scotland, Iceland and Greenland. Supplementing the pictures is an account of his experiences and of the men he met.

Dmitri is the name assumed by Levon West, who grew up on the Dakota plains, when he changed his career from that of an etcher to a photographer. His work in color photography, many of which are reproduced in this book, are some of the best examples of this new art of reproduction. Gen. H. H. Arnold, in a foreword, pays a tribute to the Air Transport Command of the Army Air Forces and states that the story and pictures in this book are a valuable contribution to the understanding of America's heroic air accomplishments.

Faith of Our Fighters, by Chaplain Ellwood C. Nance; Bethany Press, St. Louis, 1944; 304 pages, $2.00.

This compilation of many short articles, some by chaplains and some by other officers, tells of the experiences of fighting men and their spiritual reactions to the war. The attitude of fighting men toward religion has been greatly changed in this war, largely by the fine services of the chaplains of all faiths. They not only have looked after the spiritual welfare of the men but have given physical aid to the casualties. With courage equal to that of the soldiers the chaplains went with them to places of danger and shared their discomforts and battle wounds.

The book will convey a message of comfort and encouragement to the families of the men in the armed forces.

Per Ardua Ad Astra, by The Rev. Gordon Blacktop; Society for Promoting Christian Knowledge, London, 1944; 94 pages, 4*s*.

A chaplain of the Royal Air Force selected 24 addresses, which might be called short sermons, from many he delivered to men and women of the R.A.F. and has edited them to make this book. They are intended to hold the interest of airmen and to lead their minds to religious thinking.

Handbook of Chemistry and Physics, Charles D. Hodgman, Editor-in-Chief, Chemical Rubber Publishing Company, Cleveland, 1944; 2,571 pages, $4.00.

The 28th edition of a handbook containing data and information in the fields of chemistry and physics. Included in this edition is a considerable amount of completely revised material in addition to other changes and minor revisions. The table of the physical constants of industrial organic compounds and the table of the properties of commercial plastics have been completely revised.

Machine Designers' Guide, by K. W. Najder; Machine Designers' Guide, Lake Orion, Mich., 1944; 281 pages, $2.75.

A section on problems of flight has been added to this third edition of a handbook of formulas for mechanical engineers, machine designers, draftsmen, and technical students. Flight problems are treated in the same manner as other mechanical problems in the book, by means of definitions, explanations, formulas, and examples. A separate index is provided for the new section on flight problems.

Die Knickfestigkeit von Staeben und Stabwerken (Buckling Strength of Bars and Frameworks), by Julius Ratzersdorfer; Verlag von Julius Springer, Vienna, 1936; published and distributed in the public interest by authority of the Alien Property Custodian by Edwards Brothers, Inc., Ann Arbor, Mich., 1944; 321 pages, $8.80.

It is stated that the determination of the buckling strength of a straight bar with constant section is the fundamental problem of elastic stability. In 1774 Euler solved this problem. He determined the critical value of the load, as well as the behavior of the bar when this load had been exceeded. In accordance with practical requirements, the technical literature considered only the limit of stability that was called Euler's buckling formula.

However, in order to clarify the problem, more exact calculations are found to be essential. In the first chapter of this book the author takes up these questions and buckling tests in detail. Tests are rated as a valuable control within the range of validity of Hooke's law. Beyond this range a theoretic formula is set up only under certain assumptions and by means of the characteristic line of the material, while tests are an important basis of practical calculation. In the second chapter axially compressed bars under bending stress are investigated. For bars of a material that is only within certain limits of Hooke's law, deformation and critical load are determined by means of a bending theory that is modified for axial forces.

The third chapter deals with the buckling strength of bars with continuously variable section and action of force. The exact buckling loads are derived from the solution of the differential equation of the elastic line.

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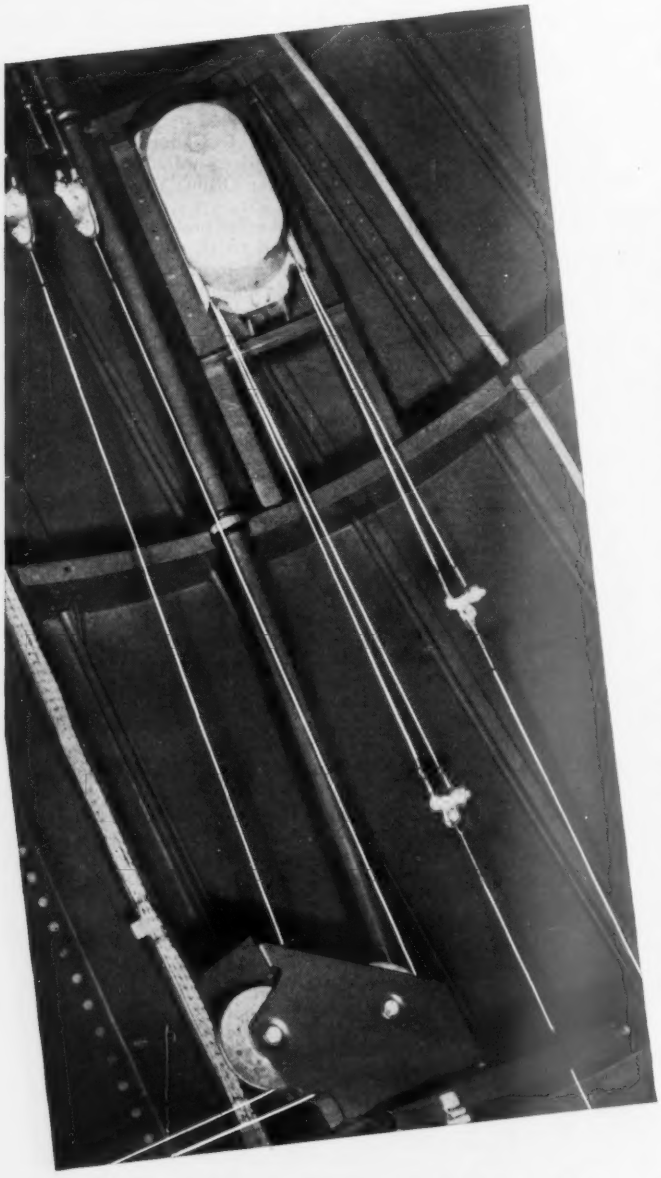

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Approximate results are determined from the integral equation of the problem by means of successive approximations or by a special method.

In the fourth chapter the calculation of the buckling load of continuously supported bars is based on the conventional assumption that there exists a linear relation between bearing pressure and deflection. Furthermore, a method is given by which a strict formulation may also be approximately brought into conformity.

The fifth chapter presents investigations of the buckling strength of ideal frameworks, framework girders, and supporting frames. There are also discussions of three-dimensional systems and other questions pertaining to the stability theory in relation to the foregoing problems.

The sixth chapter treats the buckling strength of continuous straight bars, and the problem of lateral stiffness of the pressure flanges of open bridges.

In the seventh chapter the buckling conditions of arched girders with nonvariable section, in either a circular or a parabolic form, are determined.

Handbuch der Metallbeizerei—Nichteisenmetalle (Handbook of the Pickling of Metals—Nonferrous Metals), by Otto Vogel; Verlag Chemie, Berlin, 1938; published and distributed in the public interest by authority of the Alien Property Custodian by Edwards Brothers, Inc., Ann Arbor, Mich., 1944; 262 pages, $10.50.

This is the first volume of a study on the pickling of metals, and treats nonferrous metals. Ferrous metals will be considered in a second volume, stated to be in preparation. The books are based on extensive research undertaken by the author in the pickling and blanching methods employed.

The author describes the various pickling methods in use at present, as well as the construction and equipment of pickling shops. Where older methods and equipment have proved to be practical, he ranks them equally with the most modern ones. The author had outstanding specialists in this field as collaborators.

The volume is divided into two main parts, the first giving general information about the development of the pickling of metals, arrangement and equipment of metal-pickling shops, and disposal and treatment of the waste pickling liquor. Sanitary protection in pickling shops, occupational hazards and diseases, first aid in metal-pickling shops, and accidents in metal-pickling shops are other subjects treated in the general section. The second section deals with the practical aspects, including preparation, pickling of semifinished materials made of copper or copper alloys, and pickling and annealing of finished materials made of those metals. Pickling of nickel and nickel alloys, of light metals, of tin and tin alloys, of lead and zinc, and of precious metals are dealt with in detail.

Simplified Time Study, by Herbert J. Myers; The Ronald Press Company, New York, 1944; 140 pages, $2.50.

A book written for the purpose of providing the supervisor, foreman, shop steward, or cost man with knowledge that will enable him to make a practical time study in order to obtain the information he requires. As the author's object was to make the subject as clear and simple as possible, the explanation has not been complicated by technical refinements. The information is adequate, however, and will enable the reader to get dependable results.

My Log, by Charles E. Merritt; Boone County Publications, Columbia, Mo., 1944; 160 pages, $2.00.

The second edition of a logbook for aircraft pilots includes instructions for keeping the accurate records required. The pages for records provide columns showing date of flight, aircraft and engine used, and flying hours, classified according to aircraft and engine, whether dual or solo, day or night, and by instrument or contact. Space is provided for instructors' remarks. The pages at the back of the book contain flying instructions and diagrams and suggestions for safe flying and ground practices.

Training in Industry, A Bibliography, 1943; Industrial Relations Department of The Ensign-Bickford Company, Simsbury, Conn., November, 1943; 22 pages, $0.75.

This bibliography is the result of a survey conducted to determine what has been done in the field of industrial training. It is based on information collected from a number of sources, including trade associations, universities, and libraries.

Spanish-English Military Language Manual, by Hyman Alpern and José Martel; The Gregg Publishing Company, New York, 1943; 138 pages, $1.00.

A bilingual conversation manual that deals with most of the common phases of the everyday life of the civilian and soldier in the Spanish- and English-speaking countries of the Western Hemisphere. The book is divided into two sections: Part I is a reference and conversation manual dealing with the personnel, organization, equipment, and the activities of the soldier, sailor, and aviator. Part 2 deals with everyday situations, and is suitable for laymen and military men wishing to acquire a practical conversational knowledge of Spanish or English.

English-Chinese Automotive Nomenclature, compiled and edited by Calvin C. Chang, reviewed by John K. J. Kang and George F. Fraumann; Marmon-Herrington Company, Inc., Indianapolis, 1943; 236 pages, $2.50.

This book of English-Chinese automotive nomenclature has been compiled to meet present needs and the condition brought about by the fact that, because of different Chinese dialects, an item may be known by several names. It is the author's hope that the book will assist in the standardization of Chinese automotive terms and names. This book incorporates automotive terms and names as used in connection with motor trucks, cars, tractors, combat tanks, road machinery, army automotive mechanized equipment, manufacturing and servicing equipment and tools, tires and tire equipment, and mechanical and technical terms allied to the automotive industry. Chinese names and terms are translated from English according to shape, use, application, function, or characteristics. In order to make this book complete and practical, the author has selected terms and names most commonly used throughout the automotive industry.

The Industrial Supervisor, by John M. Amiss and Traver C. Sutton; The Ronald Press Company, New York, 1944; 243 pages, $3.00.

This training guide has been written for supervisors who wish to improve their skill, leadership, and understanding of their work. It is also intended for men in the smaller shops who, not having the advantages of help from an organized industrial-training department, wish to obtain supervisory training.

The book suggests subjects to be included in study and discussion, chosen as having a direct and immediate bearing on successful department management and plant operations. The objectives of the author have been to provide material that would contribute toward the progress of the supervisor by furnishing accurate information upon which to base sound judgments; by improvement to the maximum of his attitudes toward industry in general and his job of supervision in particular, through frank discussion of management problems; and by developing skill on the part of the supervisor in carrying out his job. The 17 chapters deal with the qualifications and responsibilities of the industrial supervisor, safety measures, planning, equipment, and control of costs.

Cast Metals Handbook; American Foundrymen's Association, Chicago, 1944; 750 pages, $3.75.

This is the third edition of a handbook devoted exclusively to the engineering properties of cast metals. It contains data intended to enable the user to select the material best suited to his purpose, and to give him the information required to cooperate with foundries in obtaining castings in the most satisfactory manner. Because of the improvements made in cast metals in recent years, the book has been completely revised. It contains recommendations prepared for the guidance of designers and for buyers of castings, as well as information concerning the significance of strength and ductility tests of metals. Separate sections deal with steel, malleable iron, cast iron, and nonferrous metals. The different chapters are contributed by specialists in the particular subjects treated.

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Principles of Electronics, by Royce Gerald Kloeffler; John Wiley & Sons, Inc., New York, 1944; 175 pages, $2.50.

This textbook is an outgrowth of a course in electronics taught by the author. It is offered as a short introductory course in electronics for sophomore and junior students in electrical engineering, to be followed by mathematical treatment of electronics as applied in the communications and power field. It is also intended for practicing engineers who were graduated from college 10 years or more ago, who wish to obtain an understanding of the modern applications of the subject.

Included are chapters on the electron, the atom, electricity, gaseous conduction, different kinds of electronic tubes, and rectifying devices. Some physical theories are discussed. There are also chapters on photoelectric devices and electronic applications and circuits.

Hi-Sky!, by Flying Officer Alec McAlister; The Reyerson Press, Toronto, 1944; 124 pages, $2.00.

The British Commonwealth Air Training Plan made Canada a great center for the instruction of pilots. Canadians, Americans, and Norweigans were trained by the thousands and have made glorious records in combat. The author tells the story of his experiences as a student in the Royal Canadian Air Force.

Many chapters relate conversations in and around the airfields. They give the personal impressions of the point of view of these boys who are undergoing new experiences in discipline and rigorous routine.

By reading this book friends and relatives of every airman who has won his wings will share their ups and downs and get a better idea of what it means to become a pilot.

The Air Force of To-day, by E. Colston Shepherd, revised by H. T. Winter; Blackie & Son Limited, London, 1943; 207 pages, 6*s*.

No better review of this new edition could be written than to quote the foreword by the late Sir Kingsley Wood. "In this book Mr. Shepherd has produced an absorbing and informative account of the development and work of the Royal Air Force and of the part which it plays in our scheme of National Defence. He has taken typical aspects of the life and work of the Service from its inception down to the present time, and presents them in such a way as to convey a faithful impression of the atmosphere of the air arm and of the spirit which has constantly inspired it."

Mr. Shepherd, one of the best-known aeronautical correspondents in England, not only has had the advantages of personal observation of the entire span of life of the R.A.F. but can express his thoughts with the fluency of a trained writer. The result, as it has been since 1939 when the first edition appeared, is a definite contribution to the history of the emergence of air power from small beginnings.

Onward to Victory: War Speeches by the Right Hon. Winston S. Churchill, compiled by Charles Eade; Cassell and Company Ltd., London, 1944; 278 pages, 12*s*. 6*d*.

Anything written or spoken by Winston Churchill not only is an example of forceful and clear English but usually is a contribution to the current doings in world affairs.

This compilation of his war speeches delivered in 1944 contains the letter he wrote acknowledging his being made an Honorary Commodore of the R.A.F. and receiving honorary wings. In it he pays high tribute to Lord Trenchard, the founder of the R.A.F. It was Lord Trenchard who proposed, when Churchill was Air Minister in 1919, that Mesopotamia be held by air power, thus releasing a number of Army Divisions.

In another speech he tells of the accomplishments of the late Sir Kingsley Wood as Air Minister.

Aviation Education in Secondary Schools; The National Association of Secondary-School Principals, Washington, D.C., 1944; 230 pages, $1.00.

To those who are interested in the large program of education being carried forward in high schools, the December, 1944, issue of the *Bulletin of the National Association of Secondary-School Principals* will almost be a textbook. It contains five state programs in full and a brief account of what other states are doing. This is followed by a comprehensive bibliography. Since education in this country is primarily a function of the state, programs such as have been initiated by some states can be placed in full effect only as they are followed by all states. This summary of plans and curriculums will be a useful guide to those directing the school programs of states that are at present lacking in such advanced aviation training

The articles are as follows: "The Educational Road is Open," by Edgar Fuller; "State Plans of Aviation Education"; "High School Aviation Courses in the States," by P. E. Elicker; "Aviation Education Program in New York State," by R. G. Fales and W. N. Fenninger; "Aviation Instruction in the High Schools of Washington, D.C.," by C. W. Holmes; "Bibliography of Aviation Education."

Wingate's Raiders, by Charles J. Rolo; The Viking Press, New York, 1944; 264 pages, $2.50.

The latter part of this story of one of the outstanding generals of the war in the Far East will be of special interest to Americans. It tells of the daring invasion of Burma by air by "The Wing and the Beard."

At the conference of the Allied leaders at Quebec, General Arnold had agreed to provide General Wingate with the air-borne personnel and equipment for the invasion and assigned Cols. Philip G. Cochran and John R. Alison to organize the first jungle Air Commando unit. The decision led to the first all-aerial invasion of the war against Japan. In four months they had landed troops in Burma, established airfields, destroyed a total of 102 Japanese aircraft, and dropped 800 tons of bombs on enemy positions. They engaged in 6,000 hours of combat flight.

Also included is an account of the daring rescue of wounded Raiders from a Burma jungle where an improvised flight strip had been hastily cut.

No story of the war has a more epic character than the exploits of this odd rebel of an officer who cut through red tape and defied traditional methods but who, by perseverence, saw his ideas endorsed by the highest-ranking strategists of the United Nations.

Overseas with the Air Transport Command, by Lewis E. Theiss; W. A. Wilde Company, Boston, 1944; 341 pages, $2.00.

This is a book about two members of the Air Transport Command who, by relating their experiences, give a good idea of a part of this great transportation system of 125,000 miles of airways. These volunteers describe their training and visits to the frozen north in Labrador, to South America, to Africa and back, and, finally, across Africa to China.

In their interesting accounts of flying over the routes of the eastern part of the Air Transport Command they show the great development of airports and the excellence of the operation facilities. The great pioneering work of this command has advanced, by decades, the establishment of transportation between nations.

Surface-Carrier Participation in Air Transportation, by William L. Grossman; School of Commerce, Accounts, and Finance of New York University, New York, 1944; 97 pages, $1.00.

This study was undertaken by a research staff of the Department of Public Utilities and Transportation of New York University, under the direction of Prof. William J. Grossman. It was made possible by a grant-in-aid from American Export Airlines, Inc.

After stating the issues involved in the dispute between surface carriers and the air lines and the legal principles that underlie the controversy, the arguments pro and con are given in detail. The conclusion reached by the author is that the Civil Aeronautics Act of 1938 should be amended so that surface carriers could be permitted to operate air-transport routes subject to the regulation of the Civil Aeronautics Board.

From the Pilot's Seat, by Cyprian Truss; Joseph F. Wagner, Inc., New York, 1944; 183 pages, $2.00.

A series of religious radio talks by Father Cyprian, one of the English Capuchins who live in a monastery in Providence, R.I., is published in this book. As an introduction to these sermons, he uses some of his experiences as a pilot in the R.A.F. during World War I and other flying incidents.

As an old-time pilot he knows from experience the kind of simple and direct advice and encouragement that men who fly like to hear.

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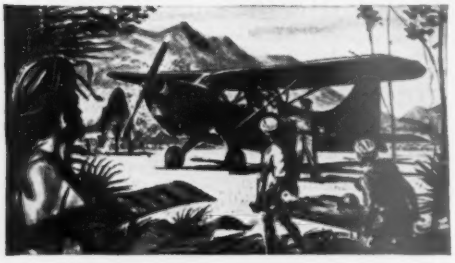
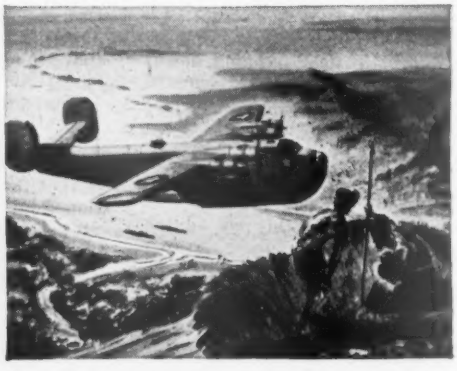
IF YOUR BOY wears flight-crew wings on his chest . . . or the ground-crew wing insignia on his shoulder . . . you can be certain that his batting average on this quiz would be 100 per cent. Before you look at the answers (*lower right corner*), read the captions under these nine pictures and see how many of the planes *you* can identify correctly . . .



1. Because it can take off even from a highway or cow pasture, this tiny Consolidated Vultee plane is used as a flying ambulance, speeding wounded men from jungle clearings to base hospitals. As an observation plane, it can hover in the air at very slow speeds, is used as "the eyes upstairs" for our artillery units and for directing tanks in action. Can you name the plane?

2. Shuttling military supplies and personnel around the world, this cargo-carrying version of the famous Consolidated Vultee long-range bomber has flown from California to Australia and back in only 95 hours and 20 minutes . . . flies regularly from the U. S. to India . . . and over "The Hump" to China. What is its name?

3. This 4-engine, long-range Consolidated Vultee bomber has made many a newspaper headline. It has bombed Axis targets from Berlin to Truk . . . was the first to strike at the Ploesti oil fields . . . has blasted that and other vital targets again and again. Can you identify this ocean-spanning heavy bomber?



4. With its crew of 10 men, this huge 4-engine Consolidated Vultee patrol bomber has played an important role for the U. S. Navy. As spacious as a railroad car, it can carry a 15-ton cargo, has a galley and sleeping quarters for its crew, can stay aloft more than a whole day at a time. Do you know this plane?

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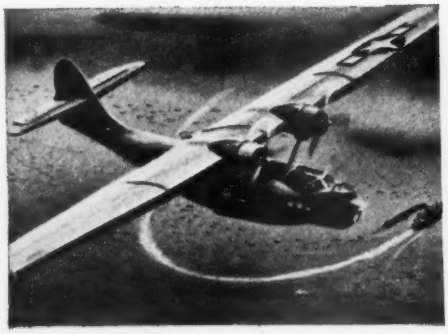

5. Tracking down the German battleship, *Bismarck*, was only *one* illustrious episode in the war history of this famous twin-engine Consolidated Vultee patrol bomber. It has also doubled as a torpedo plane, cargo carrier, an aircrew rescue plane, and even as a dive bomber! Can you name it?

6. The Japs, especially, can attest to the deadly accuracy of this hard-hitting Consolidated Vultee dive bomber. Unique hydraulic brake flaps on the wings enable the pilot to aim his bombs with amazing precision control during the dive. What is the name of this plane?

7. Your boy like most of today's military pilots probably received his basic flight training in this Consolidated Vultee two-seater. Its power, flying characteristics, and general behavior aided him in graduating to the advanced type of plane he is flying today. What is this basic trainer's name?

8. This one may stump you. It is a high-gull winged monoplane, designed and built by Consolidated Vultee. It is used for teaching British Royal Navy fliers, operating from aircraft carriers, how to navigate. Can you name it?

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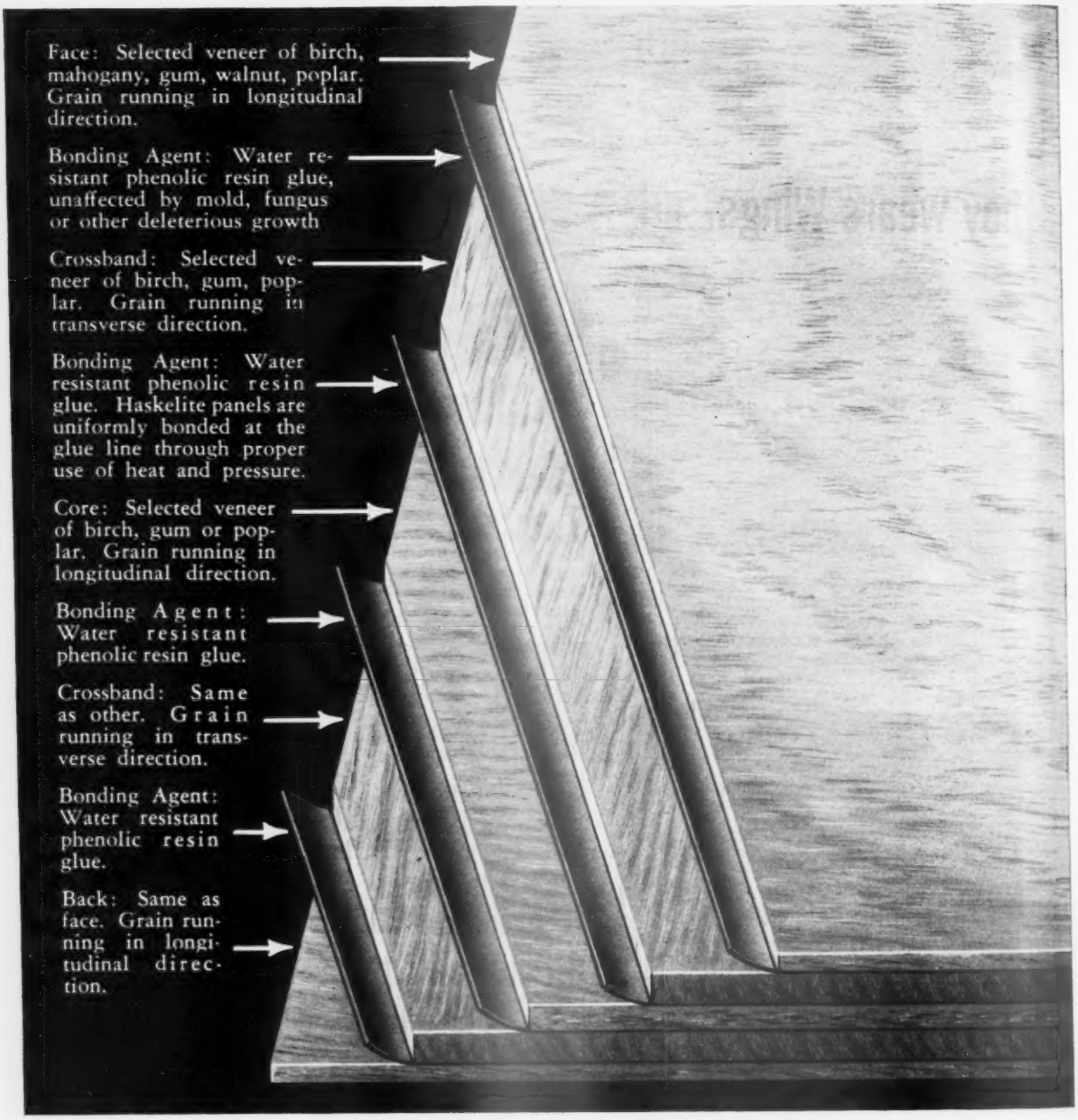
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Japan: A Geographical View, by Guy-Harold Smith and Dorothy Good with the collaboration of Shannon McCune; American Geographical Society, New York, 1943; 104 pages, $1.50.

Special Publication No. 28 in The American Geographical Society series is a compilation of data on physical geography, resources, population, and economic life of Japan at the outbreak of the present war. Tables and maps supplement the information.

With the Watchmaker at the Bench, by Donald de Carle; Pitman Publishing Corporation, New York, 1944; 239 pages, $3.00.

Fourth edition of a book on the procedures and equipment of watchmaking. The construction of various parts of a watch are described in detail. Applicability of this subject to the making and repairing of aircraft instruments is indicated.

Star Recognition, by Joseph I. Fell; Sir Isaac Pitman & Sons, Ltd., London, 1944; 45 pages, 2*s*.

The purpose of this book is to assist aircraft navigators to teach themselves to recognize the important stars and planets both accurately and rapidly, at any season or time of night and at any position on the earth. Chapters are devoted to the navigational uses of the stars, the earth and the sun, the stars, the celestial sphere, the star groups, and the solar system. Included in the book are star maps and a questionnaire for testing the student's knowledge.

Sheet Metal Theory and Practice, by John C. Butler; John Wiley and Sons, Inc., New York, 1944; 173 pages, $3.00.

A course of instruction in marine sheet-metal work contains the material prepared for the author's use in a training program at a U.S. Navy Yard. It is stated that unskilled workers were readily instructed in sheet-metal practice, enabling them to meet all production schedules on time and turn out work comparing favorably with that done by employees who had been doing the work for years. While written especially for shipbuilders, most of the material is applicable to all branches of sheet-metal work.

Navigators' Handbook, by Louis A. Baier and Allan D. Maxwell; Edwards Brothers, Inc., Ann Arbor, Mich., 1944; 62 pages, $1.00.

This is the second edition of a booklet containing diagrams, sample problems, and work sheets for use in a one-term course in navigation. It may be used to amplify lecture material or in conjunction with textbooks on navigation.

Engineering Materials, by A. W. Judge; Sir Isaac Pitman & Sons, Ltd., London, 1943; Volume I, 369 pages, 25*s*.; Volume II, 479 pages, 30*s*.

These two volumes, one of which is devoted to ferrous metals and the other to nonferrous and organic materials, have been completely revised and rewritten. They are intended primarily for manufacturers, engineers, and designers as a guide to the selection of suitable materials.

Volume I deals with the most important of the available metals, their mechanical and physical properties, composition, heat-treatments, and commercial applications.

Volume II is intended to aid those concerned with the selection and application of nonferrous metals and certain organic materials used in engineering, including plastics, the artificial and natural rubbers, abrasives, and ceramics. The needs of the aircraft and automobile engineer are given priority of consideration, and the more important requirements of the mechanical, constructional, and electrical engineer are also considered.

Inspection Approval of Firms Under the Air Navigation Acts; Air Registration Board, London, 1944; 15 pages, 1*s*.

This handbook explains the principles of approval as applied to the inspection organization of British firms engaged in the civil aircraft industry. The general lines on which an effective inspection organization can be set up and operated are indicated.

Introductory Magnetism and Electricity, by T. M. Yarwood; Macmillan and Company, Ltd., London, 1944; 159 pages, 2*s*. 6*d*.

The fundamentals of magnetism and electricity are explained in this book, which is intended for students with no previous knowledge of the subject. It covers most of the ground required for the preparation of students wishing to join the fighting services, including those who aspire to air-crew duties.

Journals Dealing with the Natural, Physical and Mathematical Sciences Published in Latin America, by Katherine Lenore Morgan; Pan American Union, Washington, D.C., 1944; 62 pages, $0.50.

This is a tentative directory of Latin American journals dealing with the natural, physical, and mathematical sciences. It has been issued as part of a plan of the Division of Intellectual Cooperation of the Pan American Union to produce educational tools that may be utilized by institutions and individuals interested in making intellectual relations with the so-called "Middle American" and South American countries a tangible reality.

Subject Headings in Physics, by Melvin J. Voigt; American Library Association, Chicago, 1944; 151 pages, $3.25.

This list contains approximately 500 subject headings and 500 cross references for use in the library cataloging of books on physics. The compiler, Head of the Library Service Section of the Research Department of General Mills, Inc., states that it is based on the 4th edition of *Subject Headings Used in the Dictionary Catalogs of the Library of Congress*. Extensive changes have been avoided, but 52 of the subject headings and 220 of the cross references differ from Library of Congress interpretation or are not used by the Library of Congress. A definition is given of each subject heading, with a reference to the source of the definition and an example of a book indexed by the heading.

The list will be useful to aeronautical librarians for cataloging books on electronics, spectrum analysis, thermodynamics, sound, and other physical subjects, as a supplementary work to the *Subject Headings* of the Library of Congress and to *Subject Headings for the Aeronautical Index*, compiled by the Division of Aeronautics of the Library of Congress.

Aircraft Plywood Bibliography; American Society of Mechanical Engineers, New York, 1944; 73 pages, $1.00.

A bibliography of books, articles, and papers on plywood for aircraft is classified according to the various methods of manufacture, properties of the product, and its uses. Special sections contain references to published matter concerning the design of plywood parts for aircraft and airplane construction and assembly in relation to plywood.

The Missing Technician in Industrial Production, by John Gloag; George Allen & Unwin Ltd., London, 1944; 108 pages, 7*s*. 6*d*.

This book describes a method of collaboration between manufacturers and industrial designers which has been tested over a number of years and is stated to have been proved useful economically. The author attempts to give some practical answers to the question of how the designer and industrialist can work together productively.

(*Continued from page 25*)

(c) Install a modern system of approach runway lights which will give the maximum assistance under adverse weather.

The three elements necessary for safe operation—suitable runway, adequate radio aid, and high-intensity lighting—must be planned and correlated together. That planning and correlation should be watched and guided and steered by the men who will use these aids. If this is not done and any one element is wrong, we do not advance and we may pay at the expense of safety.

ACKNOWLEDGMENT

Acknowledgment is made for use of official photographs of the U.S. Army Air Forces.

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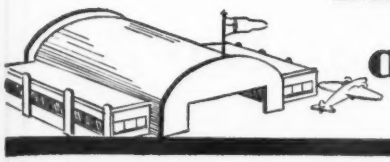

From Automobiles to Aircraft

A History of Eastern Aircraft Division. This brochure gives a detailed account of the conversion of five of the General Motors factories at Lindon, Bloomfield, and Trenton, N.J., Tarrytown, N.Y., and Baltimore, Md., from automobile production to the manufacture of Grumman airplanes. The book shows the need for fundamental changes in any factory converted to aircraft production.

Starting with five plants filled with automobile-manufacturing equipment, the General Motors group converted in an astonishingly short time to the production of the Wildcat and the Avenger. They established a record that has brought commendation from the Navy and esteem from the other companies in the aircraft industry.

The many illustrations in gravure supplement the text by showing the work from the beginning to the present. These show how a large force was recruited and how it was trained and put to work on specialized routines. The book reflects great credit on the staff of General Motors Corporation who undertook this essential program for the war effort. *Eastern Aircraft Division of General Motors Corporation.*

The Economic Place for the Airplane in Transportation

The Principles are Still the Same. R. E. Johnson. Economic fundamentals of transportation are applied to the airplane to identify the aircraft's place in the overall scheme of moving goods and passengers from place to place. It is concluded that the airplane at present cannot compete with other forms of transportation on trip lengths of 150 miles or less. This conclusion is modified by the deduction that the airplane is useful on short trips where alternate forms of transportation are not available, as in many sections of Alaska.

The principles discussed are illustrated by a series of charts. The first demonstrates the point that constant cost per ton-mile—assuming full loads—is less on long trips with large and supersize planes. The second, that volume of goods shipped increased as means of transportation in the United States improved since 1800; also that volume moving short distances exceeds long-haul gross. The third chart shows that there are more small centers of population than large ones; hence, more planes will be needed for small-city airports, but more large planes for large-city operations. The fourth, that a plane having higher take-off weight will tend to maintain low constant cost per ton-mile over longer distances than a plane with lesser take-off weight. In the fifth chart it is shown that, as the size of an airplane increases, the cost per ton-mile of transportation tends to decrease, assuming a condition of large loads and distances of maximum length. The sixth, that in the vastly increased tonnage transported by all means since 1800, the portion carried by air so far has represented the smallest portion, transported at higher cost but more swiftly. *Trade Winds,* December, 1944.

Resin Glue

The Interesting Story of Plaskon Resin Glue. A 28-page book tells the story of resin glue. The history of glue; the development of the modern, permanent-bonding, waterproof resin types; methods of using them in fabricating; and a wide range of present-day applications are described. Practically all applications are illustrated, giving the reader visual evidence of the glue's adaptability to different fields of manufacture, including the aeronautical field. *Plaskon Division of the Libbey-Owens-Ford Glass Company,* Toledo, Ohio.

Breaker Point Timer

New Light Aids Timing. Particulars are given about a timing light that has been devised for checking the internal timing of magneto breaker points, the timing of magnetos to the engine, and synchronization of magneto timing. Credited with being the means of reducing the servicing time needed for the operation by one-half, the timing lights are used by slipping a clamp, consisting of one piece of steel spring, over the magneto breaker housing and attaching an alligator clip to the breaker-point contact assembly screw. *Mid-Continent Wing Tips,* December, 1944.

Aviation Gasoline . . . From the Refinery to the Airplane

Aviation Gasoline: Handling and Storage. Information about the handling, transportation, and storage of aviation gasoline is contained in a 31-page illustrated booklet. Explaining the nature of aviation gasoline and telling of the fire and explosion hazards that are attendant upon its handling, the booklet advises on how it should be loaded in and unloaded from tankers and barges, tank cars, and tank trucks. Suggestions are also offered regarding the proper use and care of drums and smaller containers for aviation gasoline underground, above-ground, and auxiliary storage systems for the gasoline methods of sampling and testing it; and methods to be followed in delivering the gasoline to airplanes. *Standard Oil Company of New Jersey.*

Job Advancements with an Air-Line Company

Payroll Progress. Ralph S. Damon. An outline of American Airlines' pay-scale history, together with an analysis of some of the factors that have affected the company's salary levels within the past 10 years. This appraisal by the President of the company also includes an interpretation of American Airlines' present-day plan, which is based on a program of job evaluation and established rate ranges for all classifications of jobs. Three lists supplement the articles; one list compares the original jobs and remunerations of employees who have worked for the company for 10 years, with their present jobs and salaries; the other two lists demonstrate the salary increases and job-progress of employees who have worked for the company for 5 years. *Flagship World,* November–December, 1944.

Contract Termination Procedure

Manual on Contract Terminations. A manual of procedure on contract termination has been issued for the use of vendors and subcontractors concerned with the problem. Detailed information is given regarding the steps to be taken following the receipt of notice that a contract for a purchase order emanating from a Government agency has been terminated. The manual contains 137 pages and includes numerous diagrams and forms for the assistance of the users. *Jack & Heintz, Inc.,* Cleveland.

Navy Log of Mars Operations

The First Year. Operations of the XPB2M-1R (Martin Mars) from October 5, 1943, to September 15, 1944, are recorded. This summary of figures is reported to be taken from the official Navy log. *The Martin Star,* December, 1944.

Plans for Community Airports and Air parks

Community Airports and Airparks. This brochure has been prepared for the use of community airport and airpark planners as an outline to follow in the

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ANNOUNCES THE

PREPARATION OF THE

1945 EDITION

OF THE

AERONAUTICAL ENGINEERING CATALOG

In 1944 the Institute of the Aeronautical Sciences pioneered with the publication of the first AERONAUTICAL ENGINEERING CATALOG to fulfill the need for a reliable and standardized reference guide to the many parts, materials, and products used in the design and construction of aircraft. The need and usefulness of this first edition, which was distributed free to members on request and to a selected list of aeronautical specialists, is indicated by the fact that over 3,300 requests have already been received for the 1945 Edition.

The 1945 CATALOG is now in preparation. Member companies and others planning to have their catalog pages included should make their reservations before March 15. This deadline date also applies to free listings in the Directory Section.

INSTITUTE OF THE AERONAUTICAL SCIENCES

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establishment of facilities for the private flier. It contains a summary of the thinking of some of the best civil-aviation authorities on this phase of postwar aviation planning.

Provisions for the regularly scheduled air-transport routes must be supplemented by places where private flying may be conducted without the restrictions of air-line requirements. In this booklet will be found the answers to many of the questions that are asked of those who are making plans for the great expansion of private flying confidently predicted to come after the war ends.

Plans for airparks and even smaller landing fields are given. The uses to which they may be put, how to choose a site, and the revenue to be derived from such air facilities are all fully described, thus making the text and pictures an invaluable suggestive aid to forward-looking communities. *Esso, Inc.*, New York.

High Wet-Strength Map Paper

Uformite 467 Simplifies Production of Army Map Paper. Problems encountered in the manufacture of satisfactory map paper for military uses are outlined. Some of the requirements which must be met by map paper for this purpose are listed. The article describes how Uformite 467, a urea formaldehyde resin, is being used to provide the necessary wet strength for map paper. *The Resinous Reporter*, December, 1944.

Civil-Aviation Policy

Worldwide Airlanes for United States Airlines is a loose-leaf booklet containing a compilation of statements of the viewpoint of the commercial air lines with regard to Government policy in the regulation of civil aviation. It quotes various documents and statements in support of the private operation of international air routes and discusses the question of competition compared with monopoly. *Airlines Committee for United States Air Policy*, Washington, D.C.

Aluminum Castings

Built Upon the Sand. A series of notes pertaining to the aluminum foundry of North American Aviation's Texas plant. Telling of how aluminum castings are made at this foundry, the notes include references about the sand that forms the pattern of the castings, the laboratory tests that insure the correct composition of the sand, the formation of the sand cores, the heating of the aluminum-alloy, and subsequent operations from the heating of the alloy until the castings are ready for final inspection and routing to the machine shop or subassembly department. *North American Skyline*, November-December, 1944.

New Data on Pioneer Instruments

New publications issued about Pioneer instruments include two service bulletins, two leaflets on tools and fixtures, and a group of tables relative to the interchangeability of Autosyn instruments. Service bulletins No. 43-13B contains advice for using snubber washers on all installations requiring Lord shockmounts. Service bulletin No. 46-21 provides instructions for replacing the injector nozzle in the Demand Oxygen Regulator. Superseding No. 35-31G, leaflet No. 46-21C is used in servicing octants and sextants manufactured by the company. No. 46-21D is used in servicing turn-and-bank indicators, and supersedes No. 38-26. The tables, numbered 49-5, pertain to 26-volt, 400-cycle autosyn instruments. A new page has been issued for Pioneer Instruments' Catalog Section. Containing data on the Pioneer-Elgin Aircraft cock type No. 3315, this page is numbered 46-10C. It supersedes No. 12-3. *Eclipse-Pioneer Division of Bendix Aviation Corporation.*

Painting Bombers

Bomber "Beauty Shop." The procedures and equipment of the Paint Department at Bell Aircraft Corporation's Georgia Division are surveyed. It is related how Bell-built Superfortresses coming off the assembly line are washed off with a lacquer thinner, the metal surfaces are prepared, and then painted with one coat of primer and two coats of lacquer paint. Attention is also called to a timesaving job done by the Paint Department in cooperation with the Template Department. This operation involves the spraying of blue paint through the holes of templates, which leaves exact patterns on the metal sheets underneath the templates for the riveters to follow. *The Bell-ringer*, December, 1944.

Aircraft Relays

Aircraft Controls. No. 30-D in the company's series, this 12-page bulletin contains data regarding aircraft relays and electrical control devices. Specifications and dimensioned drawings supplement the descriptions of 200-amp., 50-amp., and 25-amp. aircraft relays and their component parts. A condensed rating-table and index include shipping and packaging information. *The Hart Manufacturing Company*, Hartford, Conn.

Pneumatic Tool Lubrication

Lubrication of Portable Air Tools. The lubrication of high-speed rotary-vane pneumatic tools for use in the production of aircraft is discussed. Information is given about the parts that require lubrication and the nature of the lubricant best suited to their protection. Illustrations show the design of pneumatic tools and of special oilers, which are attached to the air base and supply atomized oil to the tool parts. *Lubrication*, November, 1944.

Method for Reducing Concentration of Stresses by Power Brushing

A Report on Reducing Concentration of Stresses. A method of reducing a cause of failure of machine parts is described in a report by engineers of The Osborn Manufacturing Company. It is stated that "fatigue" or progressive fracture in machine parts, caused by stress concentration, can be reduced, and in many cases eliminated, by power brushing.

Proper brushing is credited with being a preventive measure, by reducing the effects of tool marks, burrs, sharp edges, and scratches. The brush blending of surfaces, edges and corners is also said to aid materially in limiting stress concentrations. In comparing the brushing method of removing burrs and other stress-concentrating defects with other fast methods for removing burrs, the report states that brushing promotes excellent stress distribution while other fast methods frequently complicate the problem by creating secondary defects.

A summary chart, listing the more commonly used wire and treated tampico brushes and their applications, is available with the report. *Osborn Manufacturing Company*, Cleveland.

Properties of Special Steels

Handbook of Special Steels. A handbook of special steels has been published to assist users in the selection of the proper types of tool, stainless, electrical, and carbon steels in the various forms produced by the Allegheny Ludlum Steel Corporation. The analyses and properties of the steels are shown in tables and charts to facilitate quick reference. *Allegheny Ludlum Steel Corporation*, Brackenridge, Pa.

Forging Engine Parts

Cyclone Blacksmithing. A study of the methods by which components of Cyclone engines are forged. The article also takes into consideration procedures of heat-treating, rough-machining, finish-grinding, and checking for tensile, hardness, and impact properties. *Trade Winds*, December, 1944.

For Airport Operators and Dealers

How to Make Small Airports Pay with Aeronca. Four Aeronca postwar planes are described briefly in a sales booklet featuring the profit possibilities in becoming an Aeronca dealer. Specifications are given on the Champion, a two-seater tandem-type airplane; the Chief, a two-place de luxe airplane; the Arrow, a two-place, low-wing airplane with retractable landing gear; and the Eagle, a de luxe four-place plane. Supplementary to this information is a review of the various revenue-producing means that are part of an airport business. The dealer is advised that income can be derived from servicing aircraft, from instruction, accessories, gasoline and oil, hangar rentals, plane rentals, sightseeing trips, and refreshment stands. *Aeronca Aircraft Corporation*, Middletown, Ohio.

Postwar Personal Plane

The Swift. Specifications and complete descriptive data are offered on the Globe Swift Model GC-1A light plane.

In the details about this two-place, "side by side" cabin, low-wing monoplane, the following characteristics are featured: "control-tower" vision, hydraulic retractable landing gear, split-type flaps, shock-strut tail wheel and roomy cabin. The Swift will be available with either 85-hp. or 100-hp. engines. With the 85-hp. engine, its maximum speed at sea level is reported to be 135 m.p.h., its cruising speed 125 m.p.h., and its cruising range 600 miles. *Globe Aircraft Corporation*, Fort Worth, Tex.

French Aviation—Past and Future

The Rise, Fall and Coming Revival of French Aviation. Genevieve Tabouis. Highlights in the history of French military and civil aviation are reviewed briefly; the effects of the war on the current status of the French aviation industry are analyzed; and possibilities inherent in France's aeronautical future are suggested. A plea is made for giving France a large share in future international air lines not only as reparation for war damages but also because of the contributions it is claimed that country can make toward the advancement of aviation. In proof of this contention, several French aircraft designs, for which the research was secretly conducted during the German occupation, are mentioned. These include designs for a twin-engined passenger-plane model suitable for continental areas such as Europe; another twin-engined passenger-plane type for average distances; a four-engined model capable of carrying heavy freight loads on transcontinental and one-stop transoceanic crossings; and a landplane type capable of flying at high altitudes and suitable for nonstop North Atlantic crossings. *The Pegasus*, January, 1945.

High-Speed Electric Hand Tool

More Power to You. The Precise-35 is a high-speed electric hand tool designed to operate at 35,000 r.p.m. and to develop $^1/_6$ hp. It weighs only 35 oz. A 4-page bulletin describes the outstanding features of this tool in detail. It also offers a cross-sectional diagram of the tool, which helps to explain its construction, operation, and applications. *Precise Products Company*, Racine, Wis.

Aviation Information for the Traveler

At Ease Aloft. With riddles, games, and directions for doing various kinds of magic tricks, this booklet is intended mainly to amuse passengers traveling aboard air liners. However, it also contains some general educational information about aviation. Facts about Latin America, global geography, time and distances around the world are included with chronologies of aviation progress and famous flights. Other pages are devoted to data on air express, air mail, and the routines of air travel. *Pan American World Airways.*

Growth of a Domestic Air Line

National Airlines. The 10-year history of National Airlines is outlined. Some brief biographic data about the President of the company, Ted Baker, supplement the information about the expansion of the company's routes and facilities. The gradual acquisition of more and better aircraft is traced and cognizance is taken of some of the airline's future plans. Among the future plans noted is an idea for a "package tour." This would be a service involving calling for the traveler at his home and delivering him right to his destination, in which the air line would assume responsibility for any other mode of travel—taxi, bus, train, or steamer. *Trade Winds*, December, 1944.

Equipment for Measuring Surface Roughness

Profilometer Catalog. Descriptions and illustrations of all Profilometer equipment are included in a recently published catalog. Specifications and prices are given regarding this device for measuring surface roughness and its accessories. The catalog also contains 4 pages of information about the nature of surface roughness, and a non-technical description of how the Profilometer measures it for production-inspection purposes.

This catalog is an enlargement of a former publication titled "Practical

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Center-spread table in this 8-page bulletin shows chemical analysis, physical properties and applications of 33 more popular alloys available in Shenango-Penn castings.

IF you use bearings, bushings, sleeves, liners, or other tubular parts, and want them stronger, denser, more uniform and more durable, write for this bulletin.

Shenango-Penn centrifugal castings have such a uniform, dense structure that their physical qualities approach those of forgings. Widely used in planes, war ships, cargo ships, war equipment of many kinds, they will have many applications in peace-time machinery and products. Get your copy of this data book, for specifications, physical properties, sizes, applications and other important information. Ask for Bulletin 143.

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Surface-Roughness Measurement." *Physicists Research Company*, Ann Arbor, Mich.

Aircraft Fasteners

Two new booklets have been issued on aircraft fasteners. The first is a catalog and parts list. Designated as Catalogue 44A, it contains descriptive data and specifications of the company's No. 4002 series. It also explains the purpose and construction of the Camloc fastener's various parts—stud assembly, grommet, removable panel, permanent structure, and receptacle. The second booklet covers the installation procedure on the same series, giving particulars about the installation of the receptacle (with rivet mounting and with single-hole mounting, the grommet, and the stud assembly). A tool list is included in this latter booklet. *Camloc Fastener Corporation*, New York.

Air-Line Restaurant Service

Skychef. This article tells the story of Sky Chefs—how the company originated, what it does, how it operates, and what its policies and procedures are. It is explained that, although Sky Chefs (which furnishes food and restaurant service to air lines and airports) is owned by American Airlines, it is an entirely separate organization from American Airlines, Inc. *Flagship World*, November-December, 1944.

Catalog of Aircraft Equipment

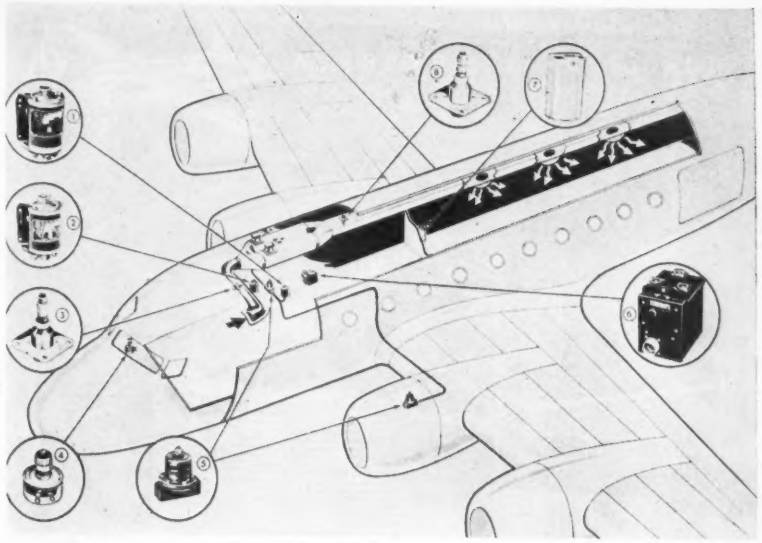
Aircraft Manual No. S1 contains data, descriptions, and illustrations of aircraft accessories and equipment. Included is information about self-sealing couplings, flexible hose lines, landing wheels and brakes, hydraulic controls, pumps and hydraulic test units, instruments, and other aircraft equipment. The catalog also contains a section of technical data comprising specification sheets, conversion tables, and technical bulletins. *Progress and Engineering Corporation Ltd.*, Toronto.

New Air-Speed Indicators

New Developments. Some details are given about a maximum allowable air-speed indicator that is adaptable to all designs of high-speed aircraft. It is explained that the instrument was developed in conjunction with the Army and the Bell Aircraft Corporation as a means of giving the pilot warning of the danger point at which he enters the shock wave pattern or exceeds the structural limits of the aircraft. Continuous indication of the safe maximum is given on the dial of a standard 700 m.p.h. air-speed indicator by a red warning signal. Determination of the safe maximum is made by an altimeter mechanism. The new instrument is interchangeable with the air-speed indicator with which planes have been equipped.

A brief description is also given of a low-range air-speed indicator with an open scale in the lower indicating range indicating down to 10 m.p.h., which has been developed to meet helicopter requirements. The instrument is also suitable for other slow-flying aircraft. It is designated as Type 586K-0151, and has a range of 10 to 150 m.p.h. for 1¾ revolutions of the indicator pointer.

The true-air-speed indicator combines an air-speed indicator, altimeter, and outside-air thermometer to give a continuous indication of true air speed. Developed in conjunction with the Army Air Forces for the purpose of increasing accuracy of bombing and navigation by eliminating the necessity for computing true air speed under combat conditions, the new indicator will also have its peacetime applications. All the necessary corrections for altitude, outside-air temperature, and compressibility are automatically applied by the mechanism. *Kollsman Pointers*, November-December, 1944.



Minneapolis-Honeywell's electronic cabin temperature control system as installed in the C-54. Nos. (1) and (5) in the diagram are safety switches and valves which automatically cut off the flow of gasoline to the heaters if the fuel line breaks. No. (2) is an air ram switch which automatically guards against operation of the heaters until sufficient forward speed is obtained to drive enough air over the heaters for adequate combustion. Nos. (3) and (8) are outside air compensators which actually turn the aircraft heaters on before a need for heat is detected within the cabin. No. (4) is a control switch, installed in the cockpit, which selects the temperatures desired. No. (6) is an amplifier, which can be installed anywhere in the plane. No. (7) is a cabinstat, installed in the space to be heated.

X-Ray Diffraction Equipment

Norelco X-Ray Diffraction Apparatus. A 12-page booklet describes X-ray diffraction techniques and applications. Diagrams, typical diffraction films, and several tabulations are given in order to show how Norelco X-ray diffraction equipment is used for identification, research, and production.

Outstanding features of the equipment are explained. Special pages are devoted to the powder camera, back-reflection-focusing camera and low-angle scatter camera. The booklet also describes briefly how X-ray diffraction films can be interpreted. *North American Philips Company, Inc.*, New York.

Explosive Rivets

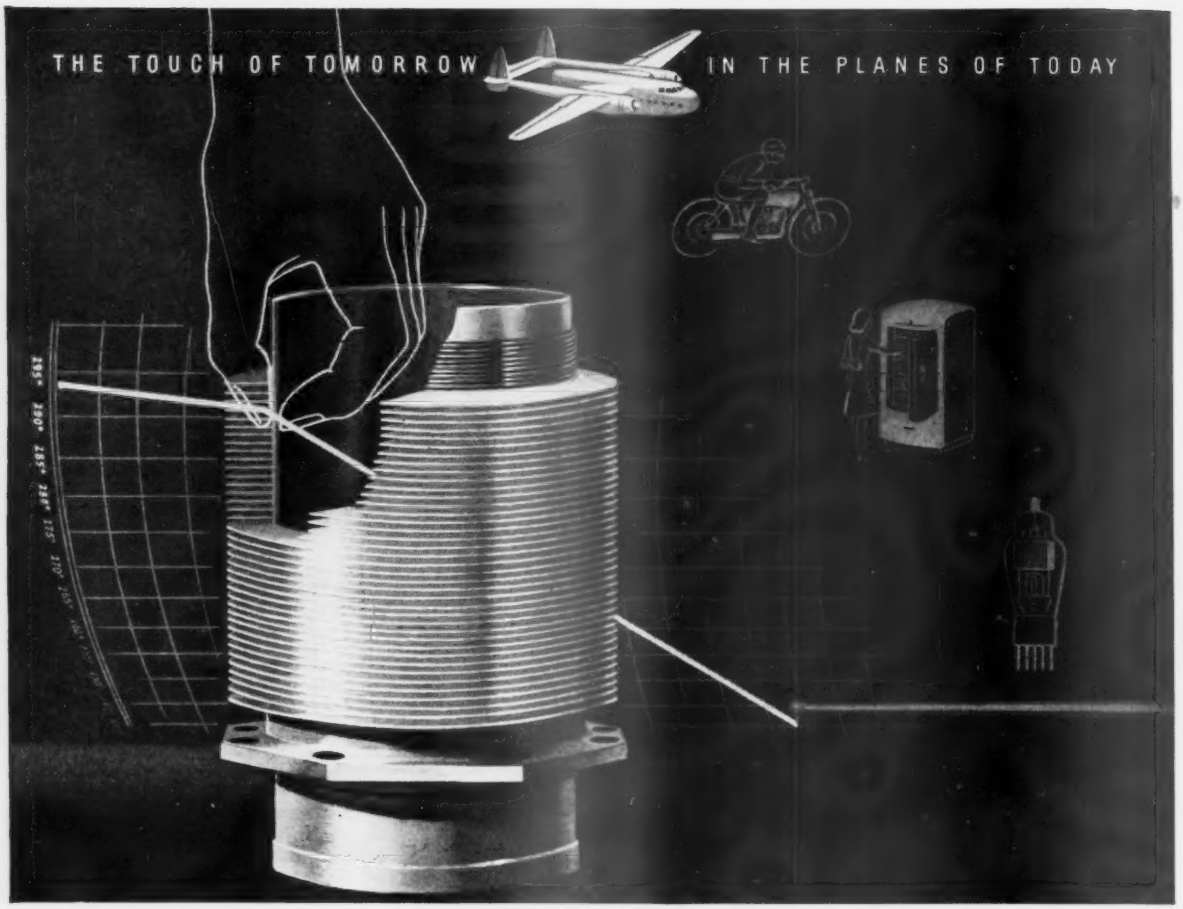
High Speed Blind Riveting with Du Pont Explosive Rivets. A 9-page booklet describes how blind-riveting operations may be speeded up with the use of improved explosive rivets. The features of the rivets are illustrated and discussed. Tables give information regarding the selection of rivets for various purposes. Equipment for the application of the rivets is described. *E. I. du Pont de Nemours & Company (Inc.)*.

Catalog of Electrical Equipment

Square D Digest No. 129, an abridged catalog of electrical equipment, has been issued. It contains descriptions, specifications, and illustrations of safety switches, service equipment, multi-breakers and other circuit breakers, panel boards, bus and feeder duct, motor-control switches, and pressure switches. *Square D Company*.

Furnace Temperature Control

Catalog N-00A(2) describes a control system designed to regulate the electric input of electrically heated furnaces so that the temperature is held at a selected control point. This booklet of 25 pages explains how, by means of an on-off contacting system, the heating unit is fed the electric current needed to keep temperature at the required control point or program. Schematic illustrations show the reader how control action is obtained by regulating the proportion of time during which current is "full on" and "full off." Installation photographs show the control system in



Milestone in Metallurgy

In 2,000 B.C., man alloyed copper with tin to make bronze.

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In the 19th century, man first successfully welded one ferrous metal to another.

Today, as result of Fairchild engineering and research, *man can now join aluminum to steel!*

Through its application to aircraft engines—the chemical bonding of aluminum to cylinder barrels—Fairchild engineers have been able to achieve far more rapid dissipation of heat—greater development of horsepower without increasing piston displacement. The Al-Fin cylinder is being used exclusively on all higher-power Ranger engines.

The future of the Al-Fin principle in aviation and other heavy-duty industries is assured.

It also has wide possibilities in the consumer field—refrigerators and radio tubes, motorcycles, family planes and autos. In appliances for home, office, factory and farm, the Al-Fin process can effect decided improvements.

Listed here are a few of the possible additional applications of the Al-Fin Process.

As you consider their magnitude consider what makes them possible—the research and engineering of an organization whose credo is "The Touch of Tomorrow in the Planes of Today."

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Pistons • Brakes

Radiators • Refrigerators
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RANGER AIRCRAFT ENGINES

Division of Fairchild Engine and Airplane Corporation • Farmingdale, Long Island

use in representative plants. Also included is an explanation of how the operator can "tune" on the control to a particular process. *Leeds & Northrup Company*, Philadelphia.

Silver-Brazing Alloy

Bulletin 11-A describes a silver-brazing alloy for brazing cemented carbide tips. Produced in both wire and strip form, this brazing alloy is stated to have a flow point of 1,270°F. Its free-flowing property is said to assure complete "wetting" of the joint surfaces. *Handy & Harman*, New York.

Propeller Production

Blades for Victory is the title of a 47-page illustrated booklet telling about the Aeroproducts propeller and the men and women who build it. The booklet is divided into three sections. Section 1 describes the engineering features of the propeller and its use on today's military aircraft. Section 2 is devoted to the machines and methods used in the quantity production of the propeller. Section 3 tells about the activities and achievements of the people who build the propeller and the recognition they have won. *Aeroproducts Division of General Motors Corporation.*

Needle Bearings for Fighters

Needle Bearing Applications in the Thunderbolt. A short article describes how needle-bearing applications contribute to the efficiency of the P-47 Thunderbolt. It is stated that needle bearings possess evident advantages in such applications through their high efficiency and small space requirements, and that their contribution, added to those of other important innovations, have enabled designers to build into the Thunderbolt the strength and power required for power dives at speeds in excess of 700 m.p.h. *The Bearing Engineer*, September-October, 1944.

Direction Indicators

Autoflight. Design details of the Autoflight direction indicator are set forth in a booklet. Information is also given about high-sensitivity resistors and bellows produced especially for aircraft instruments. *G. M. Giannini & Company, Inc.*, Pasadena, Calif.

New Products Flow Chart

A new products flow chart has been issued to provide a simple, positive means for planning the many steps and operations in the development of products. The chart is designed to enable the manufacturer to schedule the work scientifically in six basic steps of development so that the new product will be ready in time. *Designers for Industry, Inc.*, Cleveland.

History of Radio in Aviation

Radio Gets Its Wings. Harryette Creasy. A historical outline is given of early developments in the application of radio to aviation. While emphasis is placed on the milestones in the adaptation of wireless telegraphy to heavier-than-air craft, the development of radio for airplanes is also discussed. First efforts to establish communication between balloons and ground stations are described. Some details are given about the first successful radio equipment for heavier-than-air craft. Reference is made to the difficulties encountered in the development of a satisfactory aerial for this transmitter and to the ingenuity shown in overcoming them. Quotations are given from an account of how the first radio message was sent from a heavier-than-air craft. Activities of the Army in the development of radio equipment for aircraft are outlined. Some early radio equipment is illustrated and described. *Bendix Radio Engineer*, October, 1944.

Booklet on D.C. Selsyn Systems

Aircraft D-C Selsyn Systems. A booklet has been published explaining the theory and operation of the various d.c. selsyn systems, which are used as the basic principle of operation of many General Electric aircraft instruments. Sections of the booklet describe the various forms of the selsyn system and their distinctive features. Diagrams, charts, and illustrations clarify the subject. The booklet is designated as GET-1092. *General Electric Company.*

Test-Chamber Fire Protection

Fighting Fires in Carburetor Tests. The application of fire-extinguishing units for guarding against fire hazards during the testing of aircraft-engine carburetors is described. It is explained that, while the carburetors are of the fireproof type, gasoline and other hazards constantly present the possibility of fire during testing. The carburetors are tested in test chambers where atmospheric conditions simulating actual flight are reproduced. Details are given about the equipment with automatic control used for protecting against fires in the chamber and in the test room. *Kidde Industry*, November, 1944.

Production and Maintenance Suggestions

North American Aviation, Inc., Take-Off, November 3, 1944. Improved method for sharpening straight form tools used in production work on turret lathes.

Kellett News, November 1, 1944. (1) Transparent dual-purpose stencil for draftsmen and engineers; (2) turntable for holding rings at proper angle for inspection saves time in handling; (3) balancer weight that holds rim firmly for drilling eliminates use of clamps; (4) fixture for drill prevents slipping or moving of bolt keepers.

Douglas Oklahoma City Airview News, November 4, 1944. The use of scrap sheet metal of tempered material for fairing instead of soft material previously used results in saving of time and material.

North American Aviation, Inc., Take-Off, November 10, 1944. Improvement in the holding fixture for the fuel-selector valve enables parts to be assembled more easily.

The Pratt & Whitney Aircraft Wasp Nest, November, 1944. (1) New design for locating plug used in the inside grinding of cams prevents cams from being pulled out of shape; (2) serrating the bearing surfaces of a special snap gage permits gage to be worked indefinitely; (3) device for mechanically lifting heavy drill jigs.

Flagship World, November-December, 1944. (1) Wiring placards for the main fire-wall junction-box covers in a plane result in time-saving when electrical trouble shooting is necessary; (2) a jig holds the piston pin while the interior is being cleaned with a wire brush; (3) a safety cam on the lapping machine prevents the head from turning when it is inserted in the cylinder at the start of grinding; (4) a shock spring on the vertical-action reverse-arm mechanism of the lapping machine absorbs the shock of the extended finger attached to the moving shaft, which strikes the reverse arm and reverses the machine action; (5) the substitution of metal mesh bonding strips for the metal strip hose connecting bonding between the engine-mount ring and the rear engine case effects a saving of both material and man-hours.

The Jahco News, December, 1944. (1) Rapid-action chuck consisting of two collars, machined to fit over the regular chuck and operated by turning the collars in opposite directions, can be used on any worn-out chuck; (2) automatic stop on the Conematic machine prevents reversing too far.

Eastern Aircraftsman, December, 1944. Jig reduces time and labor consumed in the drilling of certain pilot holes in the lower panels of the Avenger airplane.

The Goodyear Wingfoot Clan, November 29, 1944. Improved method for removing wings from jigs saves time and obviates use of lifting devices.

General Motors Folks, December, 1944. (1) Idea for forming the cover of the ammunition box for a torpedo bomber on a forming and bending machine eliminates necessity for submitting flat stock to heat-treating; (2) new chip breaker makes possible the turning of a taper on a strut tube in one cut instead of two.

The Consolidated Vultee Eagle, December 1, 1944. System for improving processing of rough template and cutting specifications by use of paper templates.

Eclipse-Pioneer Flight Control, December, 1944. A tool for lifting and tying wires in four positions on a precision instrument assembly job reduces danger of injuring insulation on wire and results in the saving of many work-hours.

100 Pages of Technical Information

Data Book about the more Common and Useful Wrought Copper Alloys

If you are a product designer...if you specify or purchase brass and copper, you should have this informative manual. It can help you select more quickly, and secure more easily, any of the commercially important wrought copper alloys. For a complimentary copy of "Commercially Important Wrought Copper Alloys," write today on your letterhead to our Dept. AER-2.

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North American Aviation Take-off, December 8, 1944. A "one-shot" oil dispenser, designed for use on Erco riveters, ejects a set amount of oil through application of a hydraulic mechanism and, in addition, is synchronized with the Erco machine so that the oil ejection occurs at the correct time.

Douglas Santa Monica Airview News, December 12, 1944. Idea for revision of wing-flap panel.

The Chance Vought News, December 21, 1944. (1) Machine for waxing cord used in the electrical crib; (2) adjustable jig for joining the sharpening circular wood saws; (3) test board for pilot's distribution box; (4) tool for trimming air-duct parts; (5) idea for eliminating spraying in wheel wells; (6) portable tube-bending machine.

Laister-Kauffman Glider Release, December, 1944. Device for facilitating the sealing of fairing strips.

Convair News, December 22, 1944. (1) New type of tie for boxed templates eliminates welding at the joints; (2) special steel stamps to combine stamping operations and lend clarity to information stamped on templates; (3) plugging belt holes in drop-hammer dies while planing bases prevents chips from clogging anchor-bolt holes.

The Consolidated Vultee Eagle, December 8, 1944. (1) Jig for small radius on B-32 tubing for the Parker bender; (2) safety device for hoist bracket for gun turret.

The Menasco Flying M, December 8, 1944. New method of running main landing-gear cylinders in the engine lathes is based upon inserting a spud instead of chucking the cylinder.

Douglas Long Beach Airview News, November 28, 1944. (1) A stand for holding A-26 cross ties; (2) fixture for locating retainer; (3) preassembly of parts in top section of fuselage; (4) holders for flat formers in nose assembly; (5) adding rub strips to cowl flaps permits better adjustment.

Breeze American, December, 1944. (1) Idea for welding rod holders in different sizes results in lower costs and conservation of materials; (2) steel block for caps of pressure valves prevents them from flying around.

The Consolidated Vultee Volunteer, December 15, 1944. (1) Pilot light on the cooling system of hydropresses; (2) the use of a drift pin to install the bushing in the boom door hinge of the plane.

North American Aviation Take-off, December 22, 1944. A multiple-blade, box form tool, used on a turret lathe to make punches, reduces amount of time required to make the punches.

North Ameri-Kansan, December 22, 1944. The use of alignment bars for notching dies assures perfect alignment of both male and female dies, eliminates the need for burring operations, and reduces the number of resharpening and grinding operations required.

Douglas Oklahoma City Airview News, December 9, 1944. Attachment for drill-motor duplicator eliminates the laying down and picking up of the motor while moving the duplicator to next hole, eliminates the tedious insertion of the drill into duplicator brushing, and aids in prevention of tool breakage.

North American Aviation Take-Off, December 15, 1944. New type assembly drill jig enables three operations to be coordinated at one location: the sheet-metal frame for the air scoop riveted; the supporting members of the frame located; and the entire assembly then riveted.

The Consolidated Vultee Volunteer, December 8, 1944. Shortening load racks so that they lower into the degreaser eliminates putting parts to be anodized into special baskets and then lowering onto racks after degreasing.

Convair News, December 8, 1944. Supporting bracket for use on sanding machine.

(*Continued from page 113*)

ferritic- and austenitic-type filler metals were used and impact strengths were obtained in both the as-welded and heat-treated condition. The type of impact specimen selected was the simple beam type (Charpy) with a keyhole notch; the notch was variously located in weld metal, at the boundary of weld metal and parent metal, and in parent metal. The test equipment and procedure are described and the results of the tests are tabulated. *The Welding Journal*, December, 1944, pages 633-s, 634-s, 1 illus.

Cleaning of Magnesium Surfaces for Satisfactory Spot Welds. F. Linville and M. Disotell. This is a report on the results of an investigation conducted by Boeing Aircraft Company to discover the most effective cleaner for preparing the surface of magnesium alloy for spot welding. The investigation was confined to Dowmetal M, magnesium with 1.5 per cent manganese. Suitability of the various cleaners was determined by three factors: (1) the etching effect on the base metal; (2) the cleanliness of the surface; and (3) the shear value of the spot welds as determined on the Olsen machine. Tables show the optimum operating conditions for magnesium cleaners, and the effects of various cleaners on this material. It was found that hot chromic acid and chrome-nitric acid were the most effective of the cleaners tested. General conclusions of these tests favored chromic acid because of its excellent and uniform cleaning power without corrosion and dimensional change. However, chrome-nitric acid acts faster, is cheaper, and is slightly more powerful than chromic acid. *Product Engineering*, December, 1944, pages 811, 812, 2 illus.

Buckling Prevented in Welding Aluminum Sheet. How Consolidated Vultee Aircraft Corporation has developed a mechanical procedure in place of preheating for the control of buckling in welded sheet aluminum is described. The method is used on large work only. Expansion is controlled by the use of special jigs that hold the work flexibly. *The Iron Age*, December 21, 1944, pages 44, 45, 4 illus.

Miscellaneous

This Is the Ally. D. C. Alexander. A compendium of Royal Air Force and Fleet Air Arm insignia and decorations. The following are noted among the awards won by British airmen: Victoria Cross, George Cross, Distinguished Service Order, Military Cross, Military Medal, Distinguished Flying Cross, Air Force Cross, Conspicuous Gallantry Medal (Flying), Distinguished Flying Medal, Air Force Medal, and British Empire Medal. Illustrations of the various insignia are shown, as well as illustrations of some of the mentioned decorations. *Air News*, December, 1944, pages 28, 29, 53 illus.

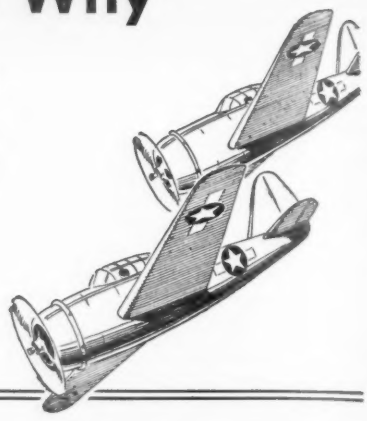
Human Pickup. Paul Gallico. An account of how the technique of picking up a living man from the ground by an airplane in full flight was perfected at Wright Field. Although indications of the value of this invention are given, the main interest of the article is centered around Lt. Alex Doster, referred to as the first man to volunteer for the human pickup experiments, rather than around technical details about the pickup equipment. Two of the facts reported are that the pickup device was developed from the package pickup and that specially trained pilots are necessary for the work. *The Saturday Evening Post*, December 23, 1944, pages 18, 19, 61, 62, 6 illus.; "Human Pickup at Cruising Speed Found Practicable in ATSC Tests," *Aviation News*, January 1, 1945, pages 11, 12, 2 illus.

Directory of Canadian Subcontractors. A two-sectioned directory includes in its first part the names and addresses of the subcontractors working for Victory Aircraft Ltd. and in its second the names and addresses of those working for de Havilland Aircraft of Canada, Ltd. Components manufactured by each subcontractor are listed. *Canadian Aviation*, December, 1944 page 128.

Here are 3 of the Reasons Why

Stainless Steel

is used in aircraft



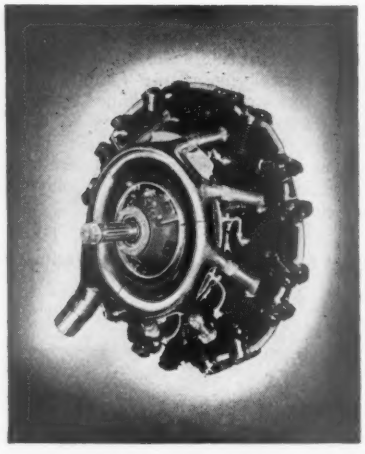
1. The high strength-weight ratio of stainless steel helps cut dead weight to a minimum.

2. Even at extremely low temperatures, stainless steel retains shock resistance, strength, and toughness.

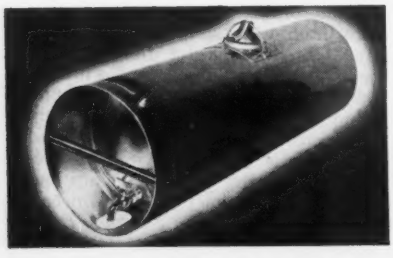
3. Stainless steel is strong and corrosion-resistant even where high temperatures are encountered.

These properties—plus high fatigue strength, low maintenance, and ease of fabrication—make stainless steel valuable for structural parts, for accessories, and in engines. The booklet, "Stainless Steel in Aircraft," gives more detailed information. Write for a copy.

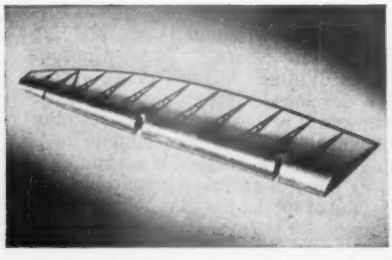
Although we do not make steel of any kind, we do produce the ferrochromium that makes steel stainless. In many years of experience, our metallurgical engineers have accumulated much information on the various types of stainless steel and their uses. This information is available to you upon request.



Because stainless steel containing columbium retains resistance to heat and corrosion, exhaust systems of relatively thin-gage metal give long service.



Stainless steel water tanks for aircraft are lightweight, strong, and shock- and rust-resistant.



Lightweight ailerons and other sections that are strong, durable, and safe can be fabricated from stainless steel.

The extra strength, plus the corrosion resistance of stainless steel, makes end sections of fuel tanks dependable.

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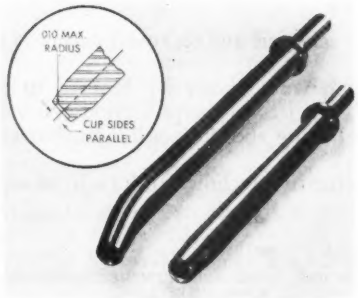
From the Industry

Improved Rivet Sets for AN 442 Rivets

Rivet sets for the flat-head, AN 442 rivets are made with cups coined for dimensional accuracy, to make the cup sides uniformly parallel and to hold the radius at the cup base to 0.010 maximum.

The manufacturer reports that the new tool was developed after observing that many aircraft manufacturers were using flush sets to drive AN 442 rivets because of dissatisfaction with the fit of AN 442 sets cupped by the conventional process.

It is claimed that the improvement will speed production and reduce worker fatigue, while virtually eliminating the physical hazard and the risk of surface damage resulting from a slipping flush set or inaccurately cupped AN 442 set. The original shape and dimensions of the rivet head are accurately preserved. The coined AN 442 cup is available in all standard sizes of both straight and offset rivet sets. Aero Tool Company, Burbank, Calif.



New rivet sets announced by the Aero Tool Company are designed to preserve the original shape and dimensions of the rivet head.

Aircraft Industry Statistics for 1944

In this three-part study, accomplishments of the aircraft industry in 1944 are reviewed and the problems of readjustment are outlined, with a brief estimate of the outlook. It shows that the American aircraft industry produced approximately 97,000 airplanes during 1944, exceeding 1943's production record by more than 11,000 aircraft. The 1944 record represents an increase of 12 per cent in production volume over 1943, when the industry produced 85,946 airplanes. Production in 1944 represented a volume of $19,400,000,000.

Figures are given for the output of the earlier years, showing that the American industry produced more than 250,800 airplanes since the beginning of 1941, and comparing American production with that of Great Britain, Germany, and Japan. Comments are made regarding the increase in production efficiency, the shift from training planes to tactical types, and the technical improvements achieved.

Problems of readjustment are discussed in connection with the eventual transfer of the industry to a peacetime basis, such as termination of war contracts, reconversion, and disposal of surpluses. Regarding the postwar outlook, estimates are given of the possible sales volume for the manufacturers and of the potential business for the air-transport organizations. Aeronautical Chamber of Commerce of America, Inc.

Air Transport Statistics for 1944

Operations of the 21 air lines of the United States during 1944 were devoted strictly to war purposes and many new marks were set in air transportation, according to a brief annual review. Eight of the lines continued to operate overseas routes to all theaters of war under contracts with the Army Transport Command and the Naval Air Transport Service, transporting troops, ammunition, equipment, and various commodities used in warfare. Thousands of flights were operated and millions of miles were flown. Many tons of cargo were transported, but the exact figures have not been announced for security reasons. Fourteen air lines operated domestic cargo routes for the Army and Navy for the greater part of the year but these services were gradually taken over by the military authorities.

On the home front the air lines also were engaged largely in the transport of passengers, mail, and cargo which had direct relation to winning the war. The number of planes in service increased to a total of 320 through the return of planes previously used by the Army for varying periods. This number, however, still left the air lines short 38 planes as compared with the total fleet of 358 in 1941. However, planes in service during 1944 were flown 11 to 12 hours daily as compared with 7 to 9 hours before December 7, 1941.

Through higher utilization of equipment, it is estimated that the domestic lines were able to carry during the year about 62,133,104 lbs. of express, not including large quantities of strictly military tonnage as compared with 57,543,591 lbs. in 1943. In 1942, the figure was 42,625,398 lbs., while the total for 1941 was only 19,398,643 lbs.

In the transport of air mail, much of which had both direct and indirect bearing upon the war effort, it was estimated that the domestic lines had flown more than 85,803,000,000 pound-miles for the year, as against 72,133,899,534 pound-miles in 1943. Indicating the growth achieved, the comparable figure for 1941 was 26,236,027,273 pound-miles.

While transporting these large quantities of mail and express, the domestic lines were at the same time carrying passengers to the estimated number of 3,658,140. Of these, 1,985,395 traveled on priorities having direct bearing on the war effort. Of the remaining 1,672,745 passengers, many were traveling on essential business, while others included members of the armed forces on leave. The actual division stood at 54 per cent priorities as against 61 per cent in 1943. The total number of passengers carried in 1943 was 3,454,040, of which 2,106,964 had priority.

The passenger load factor in 1944 also reached a new high mark of about 92 per cent, as against a 1943 figure of 82.28 per cent, while for the year previous it was 64.34 per cent, and in 1935 stood at only 49.61 per cent. Air Transport Association of America.

Stickers for Masking Name Plates

Kum-Kleen masking stickers, for masking name and instruction plates during the process of painting and finishing, are die-cut to the exact specifications of the manufacturer. The name plate is attached to the product on the production line, covered with the precut masking sticker, then the product can be painted or finished without obscuring the name plate. The stickers are applied without moistening to any smooth surface, are not affected by heat or cold, and peel off easily. Avery Adhesives, Los Angeles.

Stress Charts for Aircraft Tubing

The Ostlind column chart is a diagram designed to permit a direct reading of the column strength for a given size of aircraft tubing when the length of the column, the end fixity condition, and the type of steel are known. Conversely, it may be used to find the proper size and kind of tubing when the column load and other factors are known.

An Appreciation

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YOUNG RADIATOR COMPANY

A supplementary chart shows the properties of aircraft tubing and consists of several groups of empiric curves for the following properties: the area of metal in the cross section; the weight per lineal foot of tubing; the ratio of diameter to thickness; the moment of inertia and the radius of gyration. An example is worked out on the chart, the arrows indicating the procedure for reading the values on the various scales.

On the main column chart the curves of the allowable column stresses for the various types of steel tubing shown in Table 4-1 of ANC-5 (amended October 22, 1943) are constructed by plotting allowable stress against the effective slenderness ratio, using the formulas in this table. There is also a group of curves representing the effective column lengths, constructed by plotting the slenderness ratio against the radius of gyration. Finally, there are radiating straight lines representing the areas of metal in the tubing cross section. These are located by plotting the column strength against the allowable column stress.

To the right of the diagram, there are two double-sided scales for converting the actual column length to effective column length for end fixity coefficients 2 and 3, respectively. An example of how to find the column strength for a given tube and conditions is shown on the chart.

The diagram can be used for columns having cross sections other than those of round tubes if proper consideration is given to local instability and the column stress curves marked D/T are used. The X4130 steel column stress curves are cut off for welding after heat-treating, and the column stress curves for the heat-treated alloy steel are cut off for heat-treating after welding. The chart lends itself easily to interpolation for all intermediate values, but care should be taken to interpolate along horizontal or vertical lines only.

The Internal Pressure Chart for Round Steel Tubing is designed to show a safe working pressure for round steel tubes of outside diameter up to 10 in., wall thickness from 0.035 in. to 1 in., ultimate tensile strength of steel from 40,000 to 100,000 lbs. per sq in., and safety factors from 2 to 6.

For the purpose of plotting the wall-thickness curves on the chart the values of ultimate pressure were calculated for each thickness and outside diameter by each of the six most frequently used formulas, that is the Common, Barlow, Boardman, Mean Radius, Lamé, and Clavarino. Then the average result of the first two named, or "thin-tube," formulas was compared with the average result of the last four, or "thick-tube," formulas and in each case whichever was the lower was used in plotting the curves. For all values of ultimate pressure equal to or less than one-sixth of ultimate tensile stress, the averages of the thin-tube formulas were the lower, while for all greater values the averages of the thick-tube formulas were the more conservative. The dividing line is marked A-A on the chart. The calculations were based on cold-drawn, average wall steel tubing and the values of ultimate tensile strength were reduced by 10 per cent to compensate for a possible variation in wall thickness.

The diagram was primarily designed for low-carbon, soft annealed steel having ultimate tensile strength of 48,000 lbs. per sq.in. and for this reason it permits a direct reading on the lower scale of ultimate pressure for any tube size of this steel by going from the outside-diameter scale horizontally to the wall-thickness curve, thence vertically down to the ultimate-pressure scale. By stopping at the desired safety factor line (one of the radial straight lines), and returning to the left vertical scale, the safe allowable pressure may be read on this scale for steel of 48,000 lbs. per sq.in.

In order to make the chart usable for steels having other strength characteristics, another set of radiating straight lines was introduced, designated as 40,000 up to 100,000 lbs. per sq.in. ultimate tensile strength. By returning horizontally to the proper steel line, thence vertically to the scale, the allowable pressure may be read for the steel and tube in question. An example is worked out on the chart. Baker Steel and Tube Company, Los Angeles.

Releases are printed as received from companies and other aeronautical organizations and the responsibility for the accuracy of all statements is therefore not assumed by the Aeronautical Engineering Review.

Improved Airport Methods

Proposed new aircraft-docking and cargo-handling techniques have been evolved from a series of studies made to expedite loading and handling of future transport airplanes, such as the Boeing Stratocruiser. Forward docking and the separation of cargo, passenger, and nonpassenger traffic lanes were included among the recommended innovations.

The terminal scheme is intended to make it possible for ground operations to keep pace with the increased air speeds promised for the future, particularly in areas of dense traffic where ground facilities were worked at almost their peak capacity even in prewar days. Separation of traffic lanes permits greater cargo loads to be carried without delaying passengers, and the loading ramp to the passenger cabin, as well as aircraft servicing and most of the cargo-handling personnel, are protected from the weather.

Forward docking involves nosing the plane into a covered dock at the terminal. All cargo and mail is brought by truck to the ground floor, which is level with the airport apron. Passengers are loaded by a gangway direct from the second floor, eliminating the necessity for climbing a stairway to board the plane. An overhanging roof on the second story shelters the passengers from the weather, while the remainder of the second-floor roof provides an observation area for spectators. Speed in refueling the plane at stops is accomplished through fuel lines built into the overhanging roof.

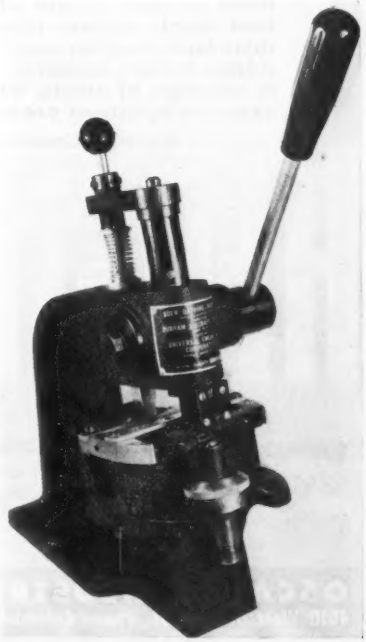
Passenger baggage is chuted from the second floor to the cargo floor where it is handled as cargo, and moved by tractor-train to the plane. Lift-fork trucks and preloaded cargo platforms speed the loading of air cargo and baggage. Boeing Aircraft Company.

Waterproofing Compound for Metal Joints and Spot-Welded Seams

No. 3909 Dolfinite Chromate Sealer is a material designed for water- and air-proofing all types of metal joints and spot-welded seams. It is reported to remain flexible and elastic under temperatures ranging down to −60°F. It is applied with a knife by hand or by air-pressure gun and does not interfere with spot or arc welding. The Dolphin Paint & Varnish Company, Toledo, O.

Spark-Plug Gap Adjuster

The Oden spark-plug gap-setting machine is now available commercially. It was designed to quickly and accurately set two gaps at the same time on Aero, BG, Bendix, and Champion spark plugs. The maker reports that an inexperienced operator, after a few hours' experience with this machine, can accurately perform the work of gap adjustment on 4,000 to 5,000 spark plugs in a working day without fatigue or eyestrain.



Oden spark-plug gap-setting machine.

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THE magnitude of the task before America has been brought sharply home to us by recent events in Europe.

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Once the machine is adjusted for the gap-setting operation for a particular type of spark plug, many thousands of plugs can be "gapped" and the only maintenance necessary is the changing of the feeler gages after every thousand plugs to compensate for wear. Durham Aircraft Service, Inc., Flushing, N.Y.

Dive-Brake Actuators

Two self-contained electric-motor driven actuating units, each not much larger than a man's hand, provide the power to operate the dive brakes on Lockheed P-38 fighters. These linear actuators were developed to provide uniform flap operation on both wing panels and to meet stringent weight and size specifications. In addition, the units were laid out to fit the wing sections of present P-38 fighters as well as earlier models now in combat zones, without necessitating major structural modifications in either case.

The power package of each unit is a $1^1/_4$ hp., 10,000 r.p.m. electric motor, equipped with magnetic clutch and brake to prevent overtravel. The screw-jack actuator is operated by a double gear-reduction unit designed as an integral part of the device. The screw-jack actuator exerts a maximum force of 3,000 lbs., with $2^1/_2$ in. travel on the jack in less than 2 sec. A control gear-reduction drive turns cams for opening and closing specially developed limit-travel switches. An additional take-off shaft is provided for a positioning indicator. Electrical Engineering & Manufacturing Corporation, Los Angeles.

Specifications of C-82 Packet

Additional specifications have been released for the Fairchild C-82 Packet, as follows: span, 106 ft. $6^3/_4$ in.; overall length, 75 ft. $10^1/_4$ in.; overall height, 26 ft. 4 in.; cargo compartment, 8 ft. by 8 ft. by 28 ft. plus 6 ft. 6 in. by 8 ft. by 10 ft.; wing area, 1,400 sq.ft.; gross weight, 42,000 lbs., alternate 50,000 lbs. (approx.); weight empty, 26,530 lbs.; crew (military) 5; capacity, as paratroop carrier, 42; as ambulance, 34 litters and 4 attendants.

In a third revision of a data sheet, specifications and other information are given about the PT-19A, PT-23, and the PT-26 primary trainers, the UC-61K and UC-61A utility cargo planes, the AT-21 advanced gunnery trainer, the XAT-13 bomber-crew trainer and the XAT-15 bombardier trainer. A directory of the personnel of the Hagerstown plants is included. Fairchild Aircraft Division of Fairchild Engine & Airplane Corporation.

Device for Aerial Photography at Night

An electronic control that automatically synchronizes a new-type shutter for aircraft cameras with the bursting of a flash bomb enables military observers to photograph from high altitudes and at night the destruction caused by their explosives.

Use of this unique control permits the camera to take advantage of the peak illumination of the bomb by beginning an exposure in approximately $^1/_{100}$ sec. after the flash bursts. After the desired exposure time has elapsed, the control closes the shutter. At the same time the camera automatically rewinds the film and gets ready for another exposure, permitting another picture to be taken automatically as soon as the next bomb explodes.

The device operates by means of a photoelectric cell that acts on the light impulse coming from the bomb. When the bomb explodes, the photoelectric cell picks up a light impulse, amplifies it and transforms it into a current to which the shutter responds in less than $^1/_{500}$ sec. By using this combination, an aerial camera, otherwise of use for daylight photography only, can be converted into a camera capable of taking night photographs of the ground in great enough detail to permit the closest military study.

Weighing only 9 lbs., this robot device was designed in collaboration with The Folmer Graflex Corporation for use on reconnaissance planes and bombers. Both photoelectric cell control and shutter are shockproof in construction. General Electric Company.

Shaper Adapted for Trimming Aircraft Parts

The speed of trimming irregular edges of aircraft parts has been increased more than 500 per cent through the adaptation of a standard wood shaper equipped with a power feed. Prior to the development of this machine it was necessary to feed the work by hand, an operation that resulted in operator fatigue and low production rate.

The shaper has been used successfully, according to the company's engineers, for trimming edges of extruded sections, formed sections, and parts that have been formed from aluminum-alloy sheets on the drop-hammer or forming press. Goodyear Aircraft Corporation.

Helicopter Side Panels of Molded Laminated Plastic

Fuselage panels for the R-6 military helicopter are made of Plastiply laminated plastic, molded by the Plymold process. The producer of the panels states that lightweight, high strength, resistance to oils, acids, alkalis, weathering, and fungus were all factors in choosing this material. The panels are molded to shape during the original curing cycle, reducing the possibility of "spring back" and providing satisfactory "fit" for quantity-production assembly. Haskelite Manufacturing Corporation, Grand Rapids, Mich.

Plastic Terminal Block

A plastic terminal block is designed to be interchangeable with many standard types of AN terminal panels employing screw-type fastenings for the lugs interconnecting the desired wires.

In this terminal block, a cam-action "bridge" element bears against the lugs or terminals to be interconnected, avoiding screw fastening devices. Since it is not necessary to use wrenches to assemble wires to the terminal panels, final assembly time is materially reduced. A quick self-locking feature provides for snap-in contacts, holds the contacts firmly in position, and requires manual release by means of levers. Identification markers, coded in the same manner as conventional terminals, are applied to the disconnect lever and are clearly visible when the lever is in the locked position. The block is reported to be capable of withstanding a 3,000-volt a.c. insulation-breakdown test. The springs are made of tempered beryllium copper, silver-plated. The Paul Henry Company, Los Angeles.

Electronic Fluxmeter

The Model 256 Hickok fluxmeter utilizes an electronic circuit so connected to an indicating meter that when the exploring inductor is placed in a magnetic field the indication of the meter will be in proportion to that field. This model is designed to operate from 105–120 volts a.c., 50-cycle circuit. Other voltages and frequencies are available. Built-in voltage regulation is provided so that the indication is independent of normal line voltage fluctuations.

Magnetic flux measurements can be compared within a range of accuracy of 3 per cent required for ordinary commercial testing. Higher accuracy can be obtained by calibrating the instrument with a known gauss standard and using it shortly afterwards. The instrument has one sensitivity control. One four-position control serves the dual purpose of turning the instrument off and selecting the three sensitivity positions. The balance control is used to preset the meter at zero.

Accessories provided with the instrument include a 7-ft. power cord to connect the a.c. source of power, one standard exploring inductor that can be used to measure air gaps $^1/_2$ in. or larger, or bar- or disc-type magnets. The meter is the Hickok 4-in. rectangular size, especially designed for use in the fluxmeter. Dimensions are width, $9^1/_2$ in.; height, $10^1/_2$ in.; depth, 5 in. The net weight is 10 lbs. The Hickok Electrical Instrument Company, Cleveland.

Tow-Bar Attaching Bracket

A simple tow-bar attaching bracket has eliminated a potential source of damage to airplanes resulting from the tow bar becoming detached during ground-handling operations.

Replacing a spring-lock arrangement for holding the tow-bar pivot in place in the nose-wheel axle, the new safety device consists of a metal angle, one end of which is secured to the tow bar with a wing nut, and the other end of which is fastened to the nose-wheel strut with a steel pin passing through the strut just above the jacking point. Since the bracket attaches to the tow bar at the pivot point, it does not interfere with the up-and-down movement of the bar.

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This new three-color sixteen-page booklet—filled with application pictures and drawings—shows at a glance the outstanding features of Cherry Blind Rivets and suggests a large number of interesting new rivet uses, many of which may be applicable to your particular fastening and riveting problems. Send for it now!

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A large well-known manufacturer of high-speed military and commercial aircraft, has openings for 5 aircraft stress analysts. These men must be graduate engineers and have a minimum of 2 years in aircraft structures. These are exceptional positions with an organization having a definite post war plan.

Graduate civil structural engineers will be considered for these positions. Training, if necessary, will be provided at Company's expense.

REPLY TO

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Since the introduction of the new bracket several months ago, not a single B-26 has been damaged as a result of a tow bar breaking loose. Furthermore, ground-crew reports indicate that attaching and disengaging the tow bars is as easy, if not easier, with the new safety bracket than with the former spring lock. The new device was designed specifically for use with the B-26, but can be adapted to any tricycle-geared airplane having a jacking point on the nose-wheel strut. The Glenn L. Martin Company.

To Prevent Nose-Wheel Damage While Towing

Breakage of nose-wheel stops and scissors on B-26 Marauders, caused by too sharp turns on the part of tractors towing the airplanes, has been greatly reduced by the painting of limit marks at the base of the landing-gear struts. The stationary and turning marks are so placed that they come together forming a continuous line at a point 5° short of the stop. The marks are painted red and are easily visible to the tractor operator who knows that he has reached the limit when he sees the two marks come together. The Glenn L. Martin Company.

Oil-Drain Pan on Wheels

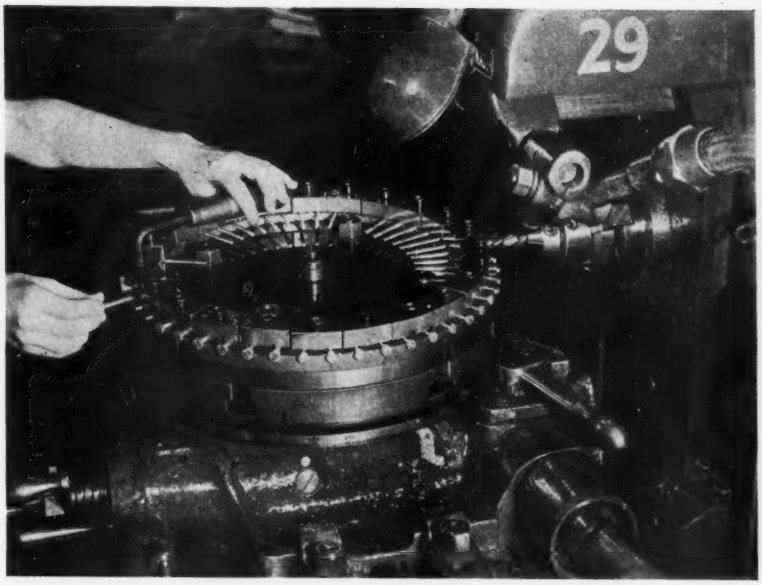
An oil-draining pan or funnel mounted on an elevated, wheeled stand saves oil and time and helps to maintain a cleaner and neater shop. It is adaptable to the needs of aircraft service and maintenance organizations as well as to those of manufacturers.

Basically the new device consists of a rectangular, sheet-metal pan about 4 in. deep and sufficiently large to extend under the entire engine. The bottom slopes down from the four sides to a petcock at the center. The pan is rigidly mounted on a metal pipe framework with wheels or casters at the four corners.

When an airplane is to be serviced, the drain pan is wheeled under the engine. Mechanics can then remove and work on the various sumps and strainers and even drain the crankcase, with assurance that no matter what part of the engine is being worked on all draining oil will be caught by the large pan. When the engine is being completely drained an oil drum is placed under the outlet pipe, but on smaller jobs, such as removing a strainer, this is unnecessary as with the petcock closed the device serves as a pan that can later be wheeled into position over a drum for final transfer of the drained oil. The Glenn L. Martin Company.

Multiple Rotary Chuck

The replacement of a single machine setup by a multiple rotary chuck to permit a continuous feed has brought about a 450 per cent production increase in a single bolt-milling operation. Previously a standard chuck was used which necessitated loosening three studs to insert and remove each bolt for the milling operation.



A new method of milling bolts by the use of a multiple rotary chuck permitting continuous feeding has resulted in a 450 per cent increase in the production of these items at The Glenn L. Martin Company.

The new method, suggested by on-the-job engineers of the Work Simplification Program, enables the operator to remove the finished bolts and insert new ones without interruption of the feed. Not only has this reduced man-hours, but in addition has released machine time for other important work. The Glenn L. Martin Company.

Gear-Cutting Machine

Utilizing a new method of gear-cutting for the production of spur and helical gears, splines, etc., the Shear-Speed machine cuts all gear teeth simultaneously with radially fed form-tool blades having a shear-cutting action. It is reported to be capable of rough and semifinish cutting as many as 60 to 100 or more gears per hour, depending on the job.

The builder's objective in the development of the machine was to bring the speed of gear-cutting up to the level set by modern gear-finishing machines. Up to the present time one gear-shaving machine has been capable of handling the output of a considerable number of shapers and hobbers, the actual number differing according to the particular job. With the new machine, production times for rough cutting and finishing can be equalized and predetermined.

The cutting action of the machine is as follows: When the gear is automatically clamped, the head of the machine containing the cutter head automatically lowers into cutting position and locks. The work reciprocates vertically. At the beginning of each upstroke, all blades are advanced radially an equal amount. On the return stroke, the blades are retracted slightly as on conventional gear-shapers to provide clearance for the tools. The amount that blades are fed into the work on each stroke is adjustable. Correct sizing of the work also is automatically controlled and adjustable.

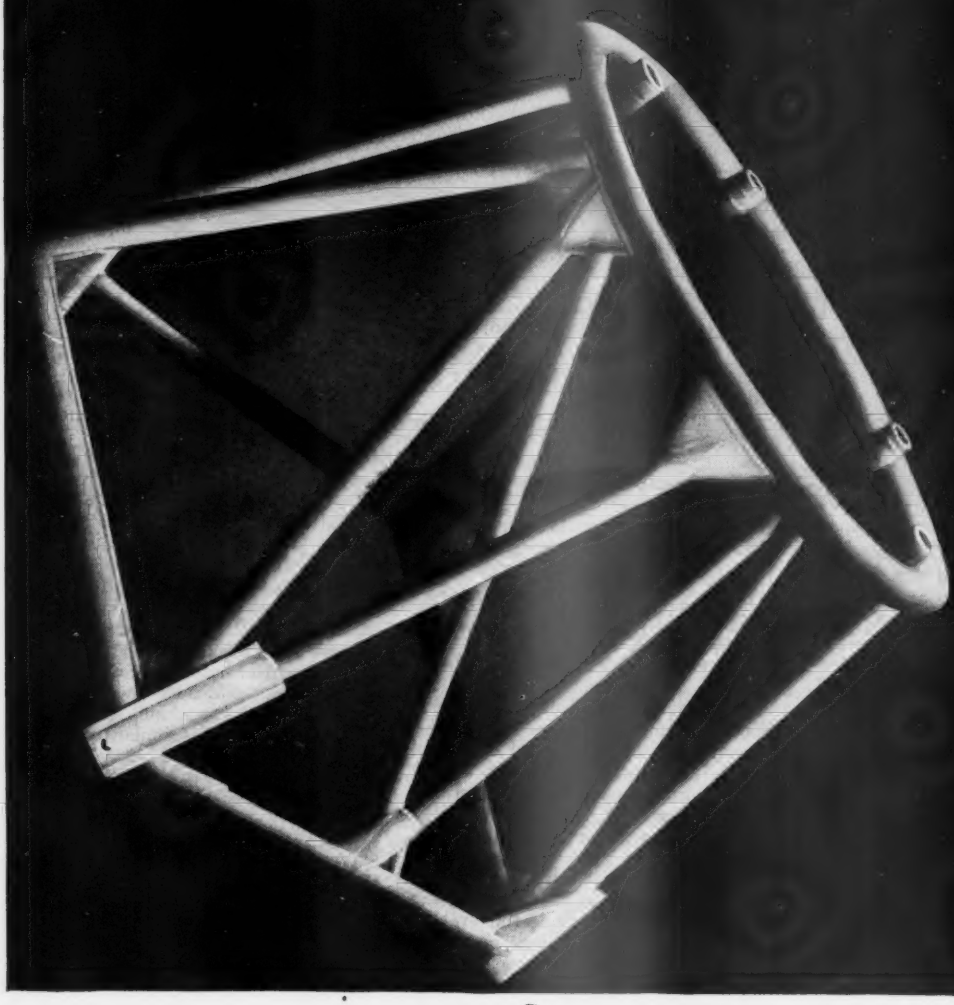
Adjustments are provided for speed of vertical reciprocation and length of stroke. A "jog" control is also provided on the machine to "inch" it for setup adjustments when shifting the machine to a different job, etc. To sharpen blades, or to change over to another type of gear to be cut, the entire inner cutter-head assembly is removed as a unit, permitting insertion of another cutter head and resumption of production. Shoulder gears can be handled on the machine, since its action in this respect is similar to that of a shaper cutter. Helical gears as well as spur gears can be cut.

One of the features of the machine is the use of balanced cutting pressure around the gear. Only a simple grinding operation is required to restore the blades to correct form. Special provision has been made for rapid chip clearance from the work, in view of the high rate of metal removal. The cutting-fluid supply is located in the base of the machine and is used under relatively high pressure to wash out the chips from the work. Michigan Tool Company, Detroit.

Electronic Temperature Controller

The Electronic Cabin Temperature Control System is a package unit weighing slightly under 8 lbs., designed to maintain automatically any cabin temperature selected by the pilot. Connected to the master control switch in the cockpit, the new control system is automatically turned on when the pilot starts the engines. Unless heat is required immediately the heating system remains inoperative until outside temperatures fall to a point requiring

The excellent fatigue resistance of molybdenum steels has proved itself in aircraft structures over a period of fifteen years.



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the addition of heat for passenger comfort. At this point, without any attention from the pilot, the heating system starts delivering heat to the cabin in the amounts needed to maintain the preselected temperature.

The electronic device anticipates atmospheric temperature changes before they can affect the interior of the cabin. The system includes an outside air compensator, which is a small coil of wire installed in the duct bringing outside air into the plane's heaters. Temperature fluctuations change the electrical resistance of the wire and the electron tubes transmit electrical impulses to a motor that opens or closes a mixing damper, regulating the mixture of outside air with heated air from the heaters.

The system also includes a cabinstat, which is another coil of wire mounted in the cabin and serving about the same function as a thermostat in a house. This responds to interior temperatures and sends impulses to the electron tubes which, getting signals from both coils, position the mixing damper to maintain the selected inside temperature. Minneapolis-Honeywell Regulator Company.

Instruction Films about Small Bearings

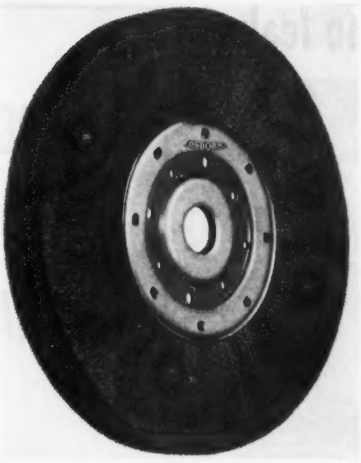
For instructing employees engaged in assembling, inspecting, and maintaining instruments, a film titled "The Care and Handling of Micro-Instrument Bearings" has been prepared. It is of 16 mm. size, black and white, with sound, and illustrates the extreme care used in the inspection and final processing operations on small New Departure ball bearings made for bombsights and various aircraft instruments. Its purpose is to impress on those who receive the bearings the importance of handling them with equal care in assembling.

Included in the precautions shown are air-conditioned working space from which dust and moisture are filtered, the use of stainless-steel work benches, the handling of bearings with kid gloves, and the use of hypodermic needles for measuring lubricant. These provisions are made to insure against the entrance of dust or lint and to prevent rust.

Another film bearing the title "Quality in the Making" illustrates the manufacturing processes followed in making New Departure ball bearings. Each film runs for approximately 20 minutes. Prints are available on a short-term loan basis for the use of plant groups, engineering societies, and engineering colleges. New Departure Div. of General Motors Corporation, Bristol, Conn.

"Round-Face" Marking Stamps

Hand stamps with round-face rather than sharp-face characters are specifically designed for the low-stress marking of lightweight alloy forgings and castings. The stamps are offered as particularly suitable for marking aluminum and magnesium-alloy parts that will be subject to either tensile or torsional stresses in service. Both face and impression are rounded to lessen the chances of cracks starting in the forgings or castings so marked.



The new Monitor power brushing wheel announced by The Osborn Manufacturing Company is said to have a cutting rate four times and a brushing life three times that of conventional power brushes for the same application.

A complete line of standard figure and letter hand stamps with round-face characters can be supplied. All characters have been carefully designed in accordance with S.A.E. aeronautical specifications which call for impressions not deeper than 0.003 in. and fillets of not less than 0.006 in. at all intersecting surfaces of an impression.

Shanks are provided either plain or knurled for finger- and thumb-gripping. Every stamp is tempered by automatically controlled heat-treating methods. The upper portion of each shank bears a characteristic "temper color" indicating that the correct degree of hardness for best withstanding mushrooming has been imparted. The tapered and rounded heads retard peening and dangerous chipping under blows. New Method Steel Stamps, Inc., Detroit.

Radar Used on Black Widow

The War Department has revealed that the Northrop Black Widow P-61 night fighter is equipped with radar for "night flying, detection, and identification." Heretofore, the Army has restricted announcement of the Black Widow's radar to the phrase "detection equipment," for reasons of military security.

Through the use of its radar, pilots of the Black Widow are able to locate enemy planes in the blackness of night. Combat reports indicate that many German and Japanese craft flying over American lines have been exploded by the P-61's armament before their crews knew of their danger.

Black Widow pilots are not permitted to fire on any enemy plane until they have made positive identification, with the result that pilots report they "ride the rudder" of hostile aircraft before opening fire, after using radar to locate the enemy. In some night battles, crews reported closing in to 200 yards before being sure enough to use the guns and cannons. Northrop Aircraft, Inc.

Power Brush for Ductile Metals

In the applications for which it has been especially designed a new power brush is reported to have a cutting rate four times as great, and a brushing life three times as long, as fine-wire brushes manufactured up to this time, according to laboratory and field tests concluded by the manufacturer.

Designated as the Osborn Monitor Brush No. 1409-S-22, it is a 12-in. monitor section filled with 0.005-in. power-brush wire and has a $1^1/_4$ in. arbor hole. It is especially well suited to aluminum, brass, and other ductile metals for removing burrs without damaging adjacent surfaces of the part, and for hardened and unhardened steel parts. The brush is also suitable for rubber parts and similar applications where there is considerable resistance to the fill-wire. The Osborn Manufacturing Company, Cleveland.

Electrode Holder

One of the innovations described by the maker of the Mor-Weld electrode holder is the heat-resisting Everlast plastic jaw cover. The quick-change, lever-action jaws can be replaced in less than a minute without tools. All parts are quickly interchangeable because there are no pins or bolts. The handle is also made of plastic, to keep it cooler under continuous operation. Pacific Engineering Corporation, Los Angeles.

Reversing Feature for Electrolimit Height Gage

The original head of the P&W Electrolimit height gage measured in one direction only. A new head carries a small lever which permits setting the gage for measuring either up or down. The gage may be furnished complete with indicator and either of two stands, or the head alone may be purchased separately. This permits owners of the previous model to substitute the new head without replacing the stand or indicator.

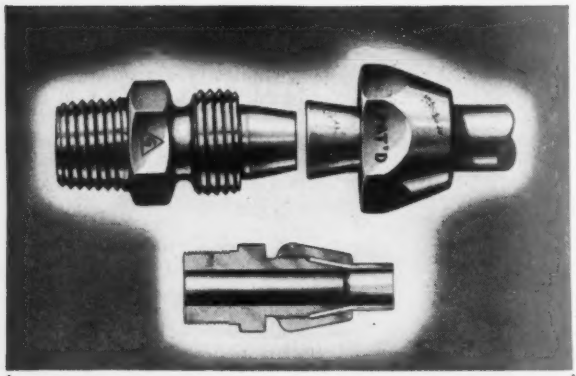
The new reversing height gage operates on the same basic principle as all P&W Electrolimit gages, that is, the translation of a mechanical movement into electrical magnification which produces very sensitive results on precision work. Mechanical parts are made by the Pratt & Whitney Division, and all coils and electrical parts are made by General Electric Company. Pratt & Whitney, Division Niles-Bement-Pond Company, West Hartford, Conn.

Protection for Threaded and Machined Parts

Thread protectors and dust caps are made of spiral-wound fiber, kraft paper, or cellulose acetate, under heat-treated compression. They are designed and constructed to protect fittings, exposed openings and ends of tubing, and other products from moisture, rust, dirt, grit, dust, or damage in packing, storage, or shipping.

These protectors are shaped to the article to be safeguarded—cylindric,

8090 lbs. pressure... no leaks*



* From Underwriter's Laboratories' Report No. 42C649 ...When ½" steel Superseal fittings, made up with steel tubing, were subjected to pressure tests, no leakage occurred. At 8090 lbs. pressure the steel tubing split at a point away from the fittings.

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Flared Tube Fittings

provide leakproof joints even under maximum vibration and pressure

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√Long 10° Tapered Cone provides greater seating area for tubing flare.

√No Shearing Action to injure the tubing at the point of flare when the nut is tightened – instead the tubing is actually strengthened.

√All Tubing Easily Flared to Superseal's 10° angle... production flaring of welded steel tubing in one operation.

√Inside Diameter of Tubing uniformly maintained . . . no obstructions at the joint.

√Tubing Bends can be made close to the fitting.

√Materials . . . Stocked in steel. Malleable iron, brass, aluminum or alloys on special order.

√Parkerized and Wax Coated . . . corrosion-resistant.

√Underwriters Approved for all hazardous gases and liquids.

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13 Detail Draftsmen with the following qualifications:

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32 Layout Draftsmen with the following qualifications:

At least four years of practical experience or four years accredited aeronautical or mechanical college education; capable of making complete layouts from sketches made by design engineers; capable of designing castings and forgings; neat and accurate work.

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square, rectangular, or tapered, crimped, flared, or perforated—with tolerances as close as ±0.003 in. Precision Paper Tube Company, Chicago.

Indexing Fixture for Hardenability Bars

An indexing fixture for Jominy hardenability bars can be mounted on either the Clark or Wilson hardness-testing machine. It consists mainly of a heavy, rigid base casting, indexing screw, and a quick-return mechanism.

The plug that supports the fixture in the hardness-tester is made of hardened and ground tool steel, projects upwards through the base casting, and forms the surface against which the diamond point presses against the Jominy bar. The screw operating the carriage back and forth is made of stainless steel and is turned by means of a brass, chrome-plate handwheel. A bronze half-nut is fastened to a quick-release lever engaging the screw.

When the test bar has reached the end of its travel, the half-nut is released and the entire carriage slides back rapidly to the new starting position. An adjustable stop automatically provides the initial starting point on the test bar. A spring plunger holds the test bar in position and allows enough freedom for the bar to rest firmly on the hardened steel stud. The instrument is finished in black Kem-Resist, with plated parts finished in chrome. Precision Scientific Company, Chicago.

Tubes for Air-Speed Measurements

Directionally shielded total-pressure tubes are designed to permit accurate measurements to be made in both air and fluids when the direction of flow is questionable. The range of usefulness, according to a chart given, is in excess of 50° angle of yaw. A variety of pitot-static tubes is available, some following the practice of the National Physics Laboratory in England, and others conforming with the standards of the American Society of Heating and Ventilating Engineers. Tubes made of stainless steel are available for surveys in hot or exhaust gases. The Venturi heads are machined from stainless steel and highly polished.

Scott Aviation Corporation's automatic steerable full-swivel tail wheel.

The Sheffield electronic piston-ring inspector.

These tubes, developed originally for engine tests, are also adaptable to flight- and wind-tunnel testing, jet-propulsion units, gas turbines, and other applications. They are described in Bulletin 302. Revere Company, Wallingford, Conn.

Improved Tail Wheel

The 1945 Model 3-24B automatic, steerable and full-swivel tail wheel is reported ready for delivery. The new wheel has improved features including needle swivel bearings, new and stronger bracket and a redesigned arm assembly. In addition to these new features, the wheel has a single arm fork of drop-forged chrome alloy, large Timken roller bearings, and a 6 in. by 2 in. solid cushion tire. Scott Aviation Corporation, Lancaster, N.Y.

Electronic Piston-Ring Inspector

The Sheffield electronic piston-ring inspector is designed to achieve a high degree of accuracy in checking piston rings. The instrument provides an electronic method for inspecting the trueness of periphery and the width of gap of a specific size of piston ring.

The piston ring to be checked is inserted inside a master ring of correct dimensional quality, which is placed on the instrument table and rotated by a power-driven roller. The gaging functions are performed by scanning beams of light directed onto photoelectric cells which energize electronic circuits to illuminate three signal lights.

As the ring revolves, one beam of light is projected on the periphery of the piston ring. A clearance between it and the master ring will result from any out-of-round conditions of the piston ring, permitting part of the light beam to fall on the photoelectric cell. This cell is set to actuate a red rejection signal should an excessive amount of light indicate that the piston ring is out-of-round beyond an acceptable point.

Should the periphery be within tolerance limits, a green signal will flash on at the end of one complete revolution, provided the width of gap is also within tolerance; a yellow signal will show if the gap is undersize. The beam of light is interrupted by a mechanical shutter arrangement at the time the gap is passing this point. Another beam of light scans the width of gap, the photoelectric cell being set to actuate a yellow signal should the gap be undersize. A third beam of light energizes another photoelectric cell set to illuminate the red rejection signal should the width of gap be oversize.

Master piston rings of known dimensional quality are used in adjusting the instrument for the desired tolerances. The instrument can be adapted to various nominal sizes, gaps of varying width, and also for variations on the allowable out-of-roundness of the periphery. It is reported that trueness of the periphery can be determined within a tolerance of 0.0001 in. With this instrument, the inspection cycle per piece is less than 5 sec., and the production rate is determined by the speed at which the rings are presented to the gage. The Sheffield Corporation, Dayton, O.

Development of British Spark Plugs

The story of the modern K.L.G. spark plug began in 1935 when leaded fuels were widely introduced. These fuels caused certain spark-plug trouble and an investigation led to the opinion that the commonly accepted mica insulation was no longer satisfactory. A new departure was made by substituting a ceramic insulator in place of the mica.

After extensive experiments it was decided that the most suitable ceramic was

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The Treasury Department acknowledges with appreciation the publication of this message by

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based on fused alumina. This produced an insulator with all the required properties, yet as distinct from porcelain as that was from mica. The new substance was termed corundite. It was not until the end of September, 1938, that the Rolls-Royce engineers were able to inform the K.L.G. company that the first 100-hour Type Development Test had been successfully completed on one of the Merlin engines. Under severe trial it had been proved that the new design of plug, incorporating then-secret features, could safely run 30-hour intervals without any attention, as compared with the standard time of 10 hours then currently accepted.

Three basic features form the essence of the British plug. The first is the substitution of a ceramic for mica as an insulator. The second—which is a major factor in the longevity of the plug—is the resistor. The third is the fine-wire platinum point device, of no greater thickness than $^1/_{300}$ in.

The story of the development of the resistor can be briefly given. The ignition leads from magneto to spark plug originally set up electrical interference with the radio equipment. To counteract this influence they were screened with a special bonding. This screening made the high-tension wire into an electrical condenser, of which the metal core of the wire formed one plate and the metallic screening the other. This condenser became charged immediately before the spark took place at the plug points and at the instant of sparking discharged itself entirely across the gap.

The excess and sudden flow of electricity thus caused made a large and very serious increase in the rate of erosion of the plug points. To avoid this a resistance was introduced, at first immediately adjacent to the plug but subsequently within the plug itself. This resistance achieved its object. The rate of erosion reverted to that normally to be expected with unscreened ignition and the life of the plug with a screened ignition system was increased more than three times. This simple device is the major cause of longevity in the plug, and it was developed by cooperation between the spark-plug company and the engine firm of Napier. The advantage of fitting fine-wire electrode points was that they followed the rise and fall of the engine temperatures almost instantaneously. Thus any oil accumulation was burned off and the plug ran with remarkable cleanliness, without causing preignition. The Society of British Aircraft Constructors, Ltd.

Vacuum-Switch Keying Relay

Originally designed for aircraft use, the Type 78CCA100 vacuum-switch keying relay also has many applications in other fields. Designed for reliability in holding its adjustments, this relay is of simplified construction, and has all parts readily accessible for inspection or adjustment. Tests reported by the manufacturer show a life far in excess of the five million-operation minimum required for units of this type.

The relay has seven poles, including one double-throw pole that handles high-voltage radio-frequency currents by means of a vacuum switch. All high-voltage parts are rounded to reduce corona. Struthers-Dunn, Inc., Philadelphia.

Copperplating on Aluminum

Adherent, uniform copperplating is now reported to be possible on aluminum and its alloys. The process consists of a specified means of aluminum cleaning and preparation, followed by a 10- to 30-sec. immersion in a dipping solution at room temperature and then plating from the known copperplating electrolytes.

The dipping solution may be used in a steel, wood, or ceramic container. There are no fumes and venting is not required. This solution is stable and not sensitive to drag-out, normal contamination or dilution. Practically any copper electrolyte can be used as the plating solution, except the sulfate types or those having a high degree of acidity. Technical Processes Division of Colonial Alloys Company, Philadelphia.

Aeronautical History in Short Feature Film

World Without Borders is a motion-picture featurette with spoken commentary and musical accompaniment, having a running time of about 20 min. It gives a brief picturization of the history of aeronautics from the first hot-air balloons of Montgolfier in 1783 to the present types of military and commercial aircraft. Much of the background material for the film was supplied by the Institute of the Aeronautical Sciences and several scenes were photographed in its offices. Pictures of historical events in aviation and of portions of the records and collections in the Aeronautical Archives and the libraries of the Institute are interspersed in the film.

The film also incorporates parts from contemporary films showing some of the glider experiments of Lilienthal, the first use of a parachute, flights of the Wright Brothers, models of the Langley aerodrome, early aircraft and flights of Glenn H. Curtiss, Henri Farman, Louis Blériot, and others. Gen. "Billy" Mitchell is shown forecasting our war with Japan and urging the importance of air power and the development of Alaska as a military air base.

The beginnings of naval aviation are shown in sequences depicting the development of aircraft carriers. The evolution of the Army Air Forces is traced from a time prior to the first World War, with the award of the "Military Aviator" insigne to General of the Army H. H. Arnold, who still wears it with his later decorations, noted. Autogiros, helicopters, and lighter-than-air craft are pictured in action.

Numerous scenes of the present war portray actual air combat and operations in which bombers, fighters, torpedo planes, and gliders participate. These sequences illustrate the functions of air power in military and naval strategy and tactics. In addition, there are scenes depicting the building of aircraft and the part taken by the aeronautical industry in the nation's war effort. Universal Pictures Company, Inc., New York.

Temperature Regulator

Modutemp is a temperature-regulating unit for oil coolers, coolant radiators, and heating systems for aircraft. It employs the principle of a temperature gap formed by two electrical contacts in a mercury thermostat which controls individual relays. The contacts are set to meet the temperature specifications and range of the individual requirements.

When the mercury falls below the temperature gap, the damper motor runs toward the heat position and both relays supply electric heat to the thermostat to assist the mercury to rise again into the gap. When the mercury enters the gap, motor operation stops and heat from No. 1 relay cuts off, slowing down the rise of the mercury. The damper holds this static position until the mercury moves out of the temperature gap between the two contacts.

If the mercury rises above the gap, the damper motor operates toward the cool position and No. 2 relay cuts off the remaining heat acting on the thermostat, tending to make the mercury fall and reenter the gap, and stopping the damper movement.

The system may be specified to operate various sizes of motors. Where hydraulic or pneumatic power is used, the device operates by means of solenoid valves. Damper positions are not limited to steps or a set number of degrees of movement. Vapor Car Heating Company, Inc., Chicago.

Scale Unit Combines High Weighing Capacity and Low Dial Graduations

The Kron Unit Weight Cabinet attachment is designed to meet industrial requirements for a high gross weighing capacity scale with low and accurate "fractional" weight dial chart graduations. This scale is equipped with standard dial mechanism, swivel head, tare and capacity beams, and drop weights.

This scale utilizes the unit-weight increment principle. By rotating the handle on the left of the cabinet front, from one to seven unit weight increments, each equivalent to the dial chart capacity, can be added to the lever system to increase the gross weighing capacity of the scale. The weight increments are indicated in a target on the dial chart as they are added to the lever system. Flexible cables connecting this target to the drop-weight mechanism allow the dial head to swivel to any desired position. The Yale & Towne Manufacturing Company, Philadelphia Division.

War shortages crop up in strange materials. Mica, for instance. Once seen principally in the windows of stoves, and in small boys' pockets, it is now used extensively as electrical insulation. In some war products, it is virtually indispensable: capacitors for radio, spark-plugs for airplane engines, insulators in electronic tubes.

With demand mounting, manufacturers were desperate. A four-man technical mission flew to London to help ration the world's supply between the United States and Great Britain. The shortage was serious.

The War Production Board, convinced that much mica was classified too low when judged by appearance alone, asked Bell Telephone Laboratories to develop a new method of electrical tests. The Laboratories were able to do this quickly and successfully because of their basic knowledge and experience in this field.

The new tests were made available to manufacturers in this country and abroad—the supply of usable mica was increased 60% — and a difficult situation relieved.

Skill to do this and other war jobs is at hand in Bell Laboratories because, year after year, the Laboratories have been at work for the Bell System.

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